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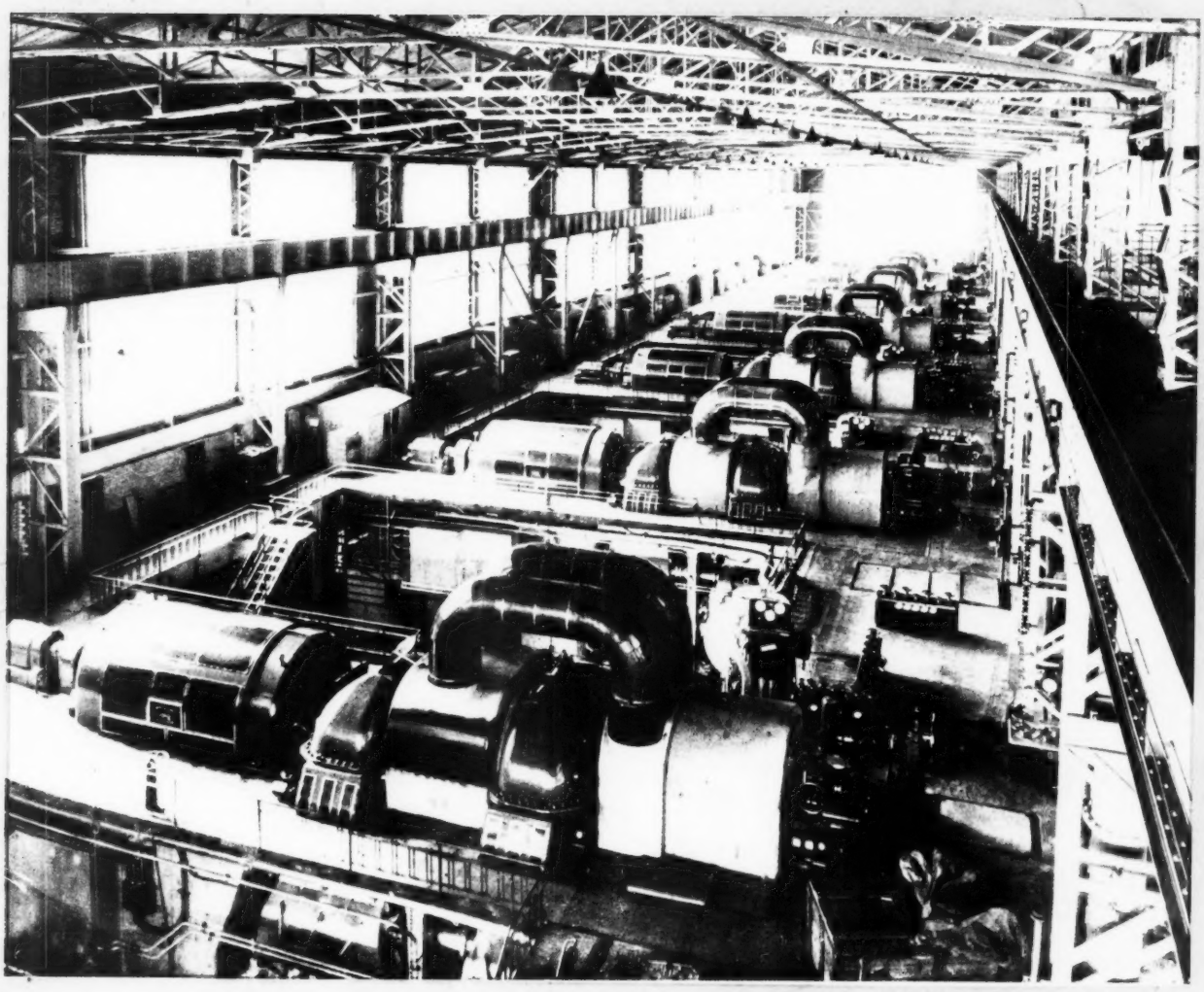

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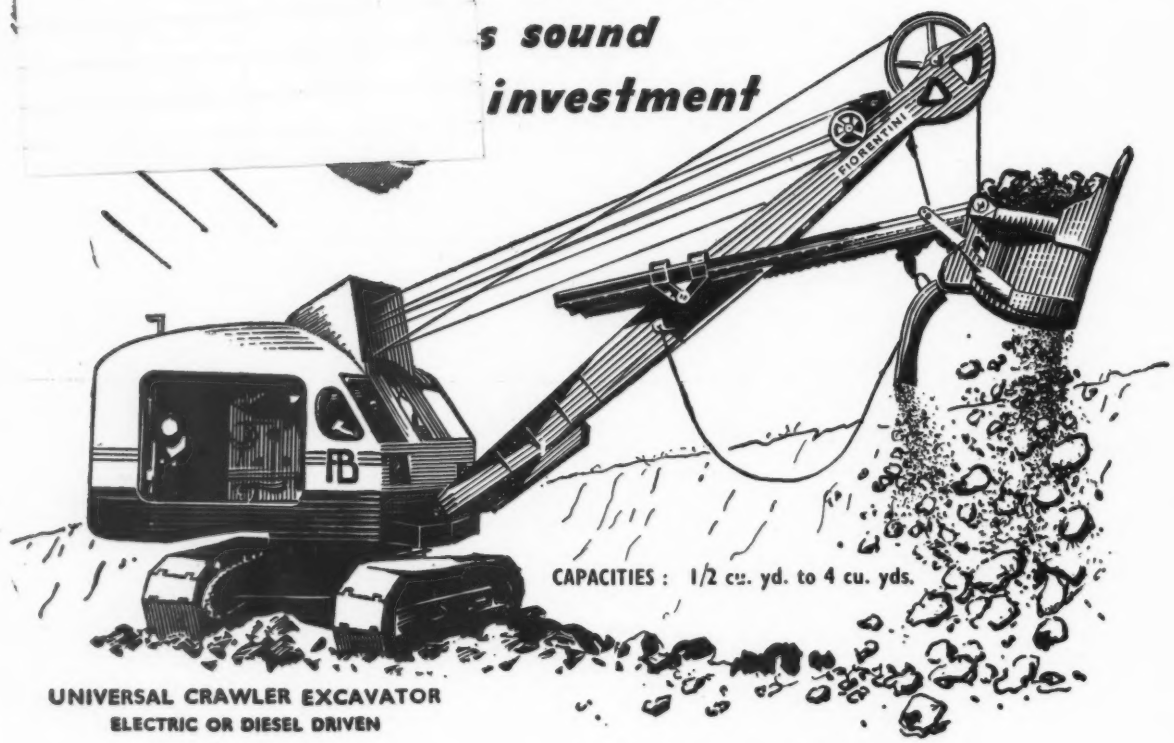

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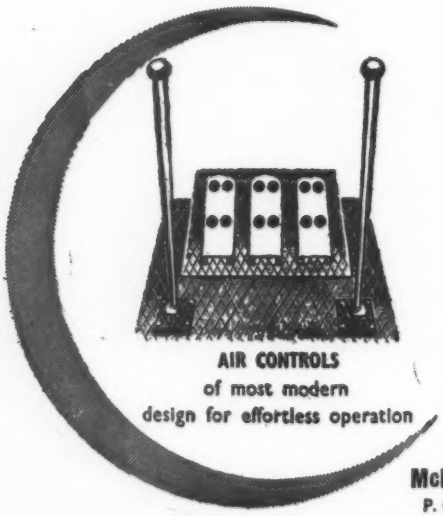

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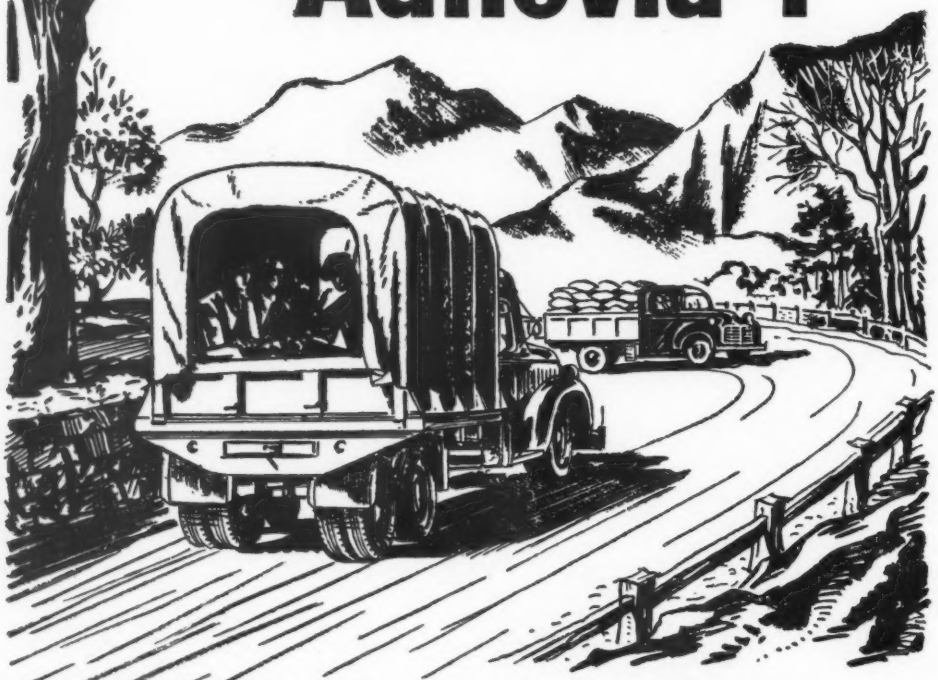

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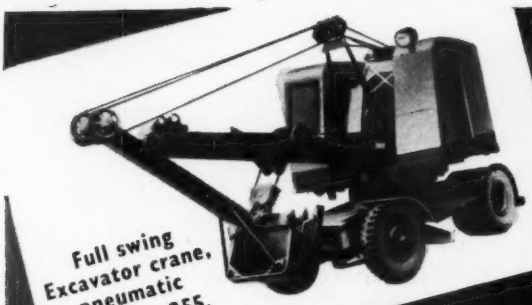
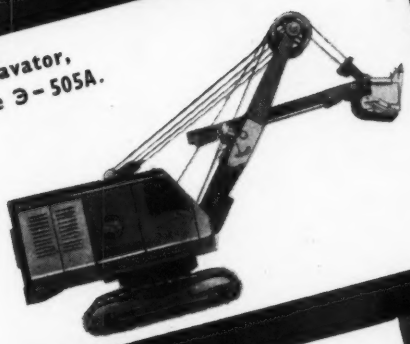
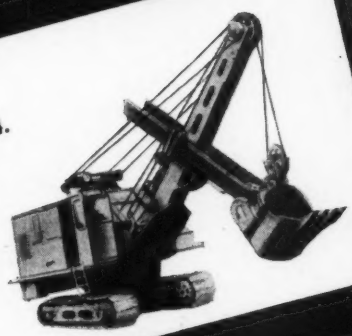


Full swing Excavator crane, pneumatic Э – 255.

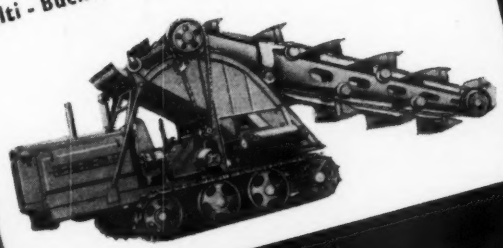


Excavator, type Э – 505A.



Excavator type Э – 1004.

Multi - Bucket Trench Excavator, Type ЭТН – 251.



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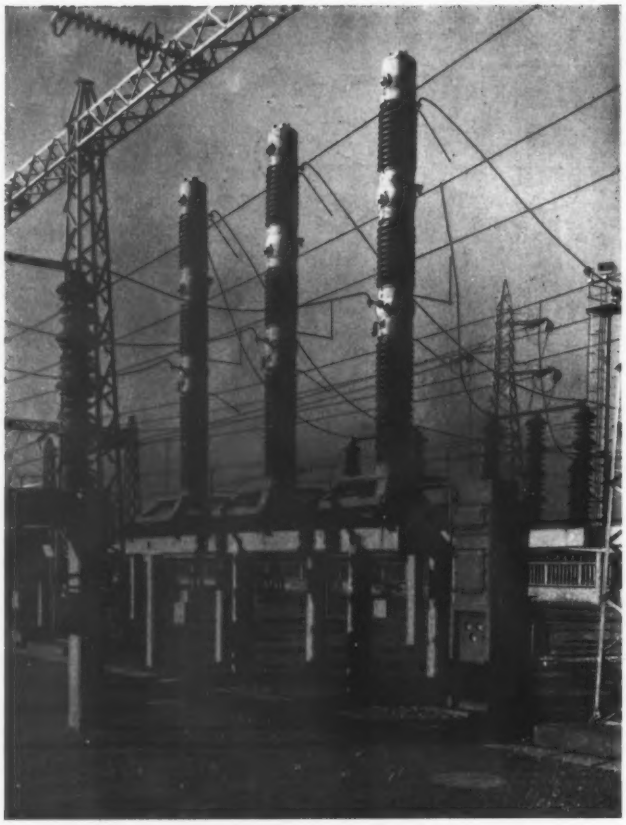

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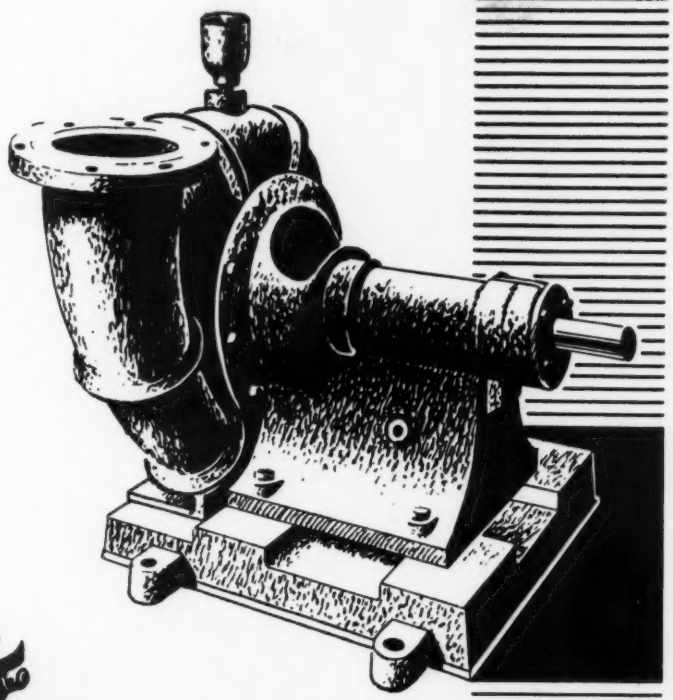

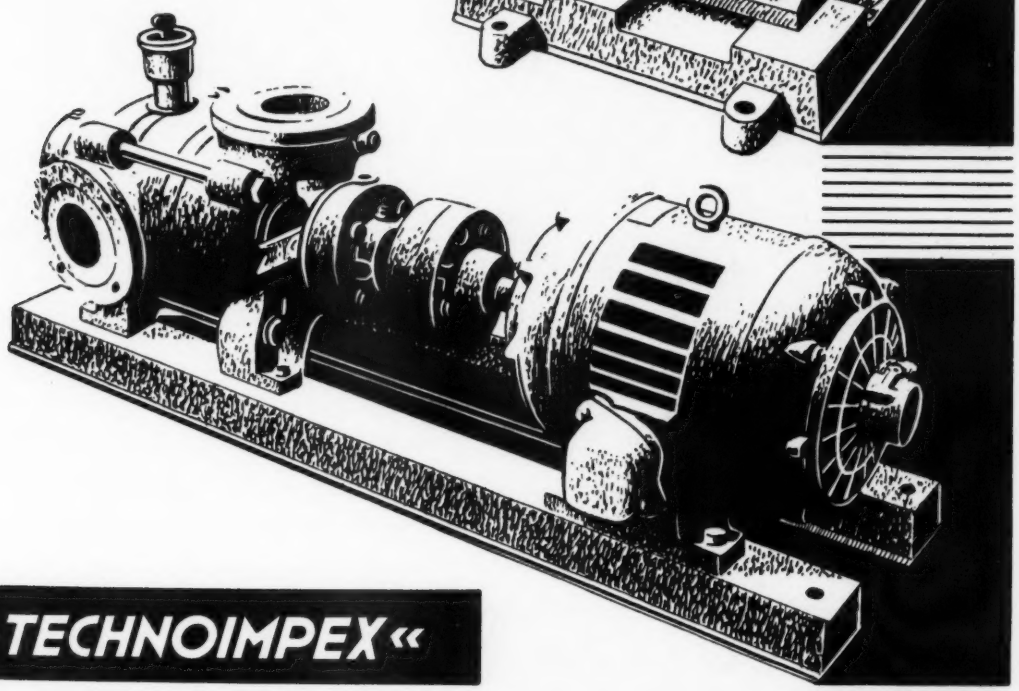

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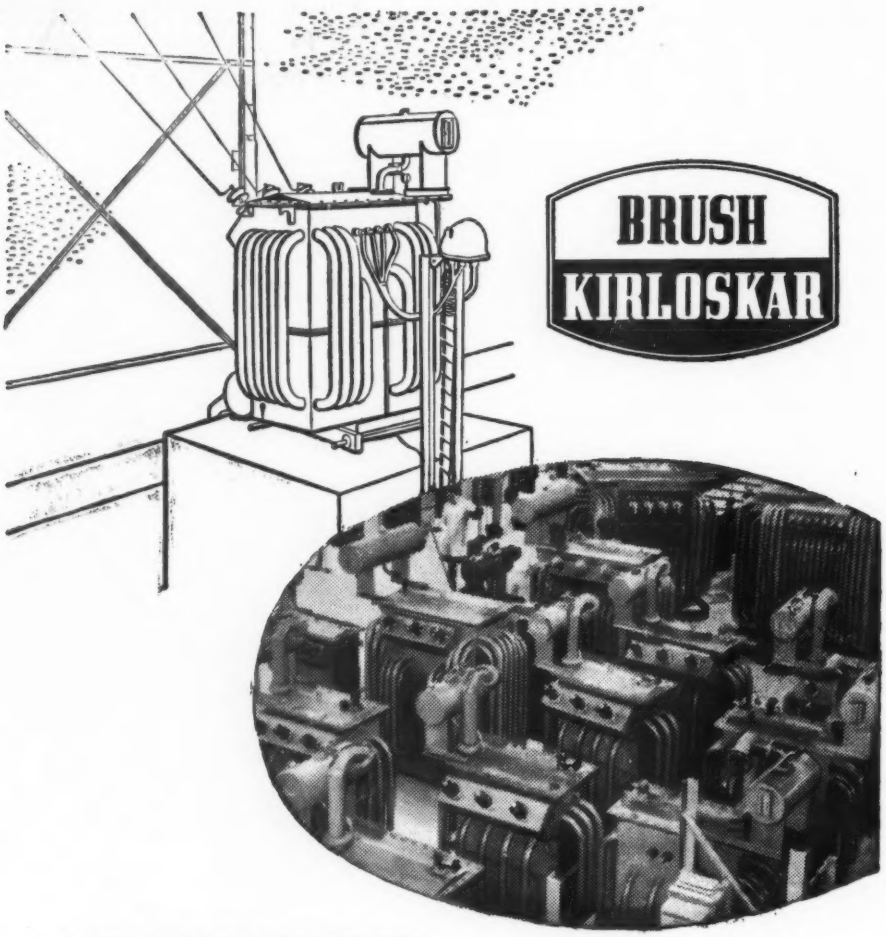

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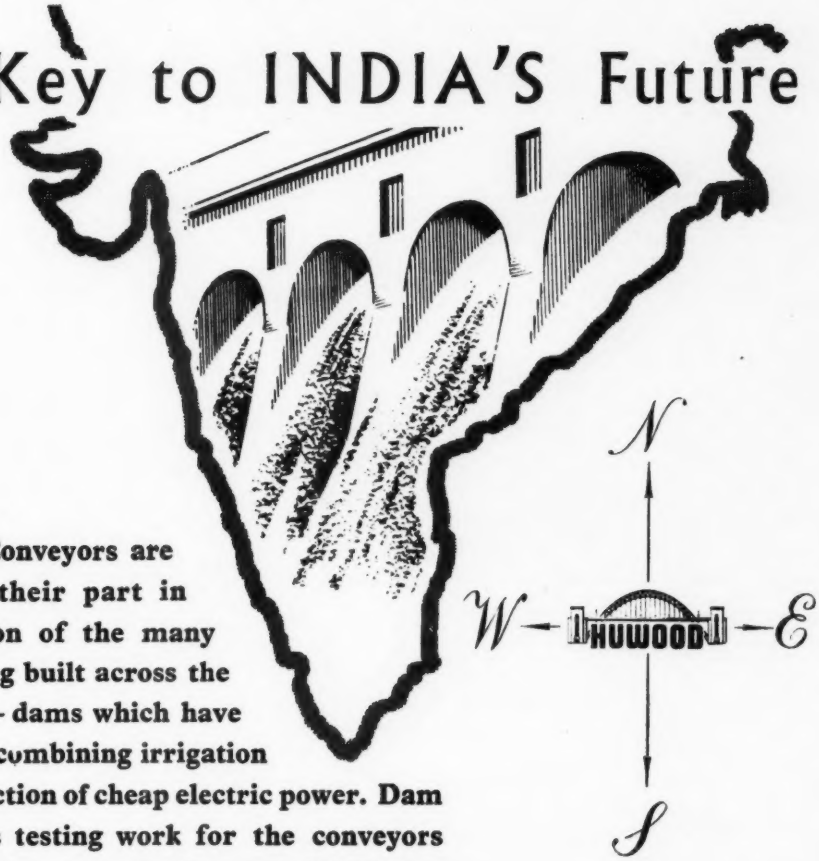

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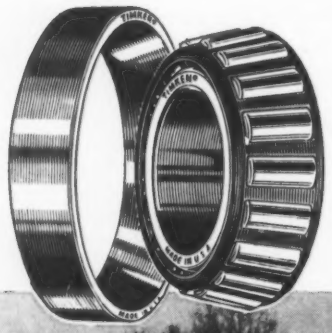

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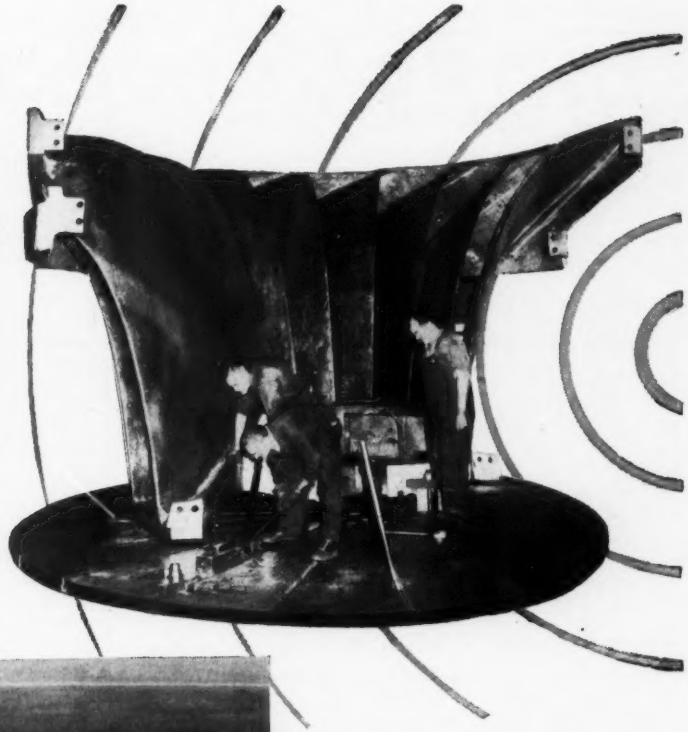

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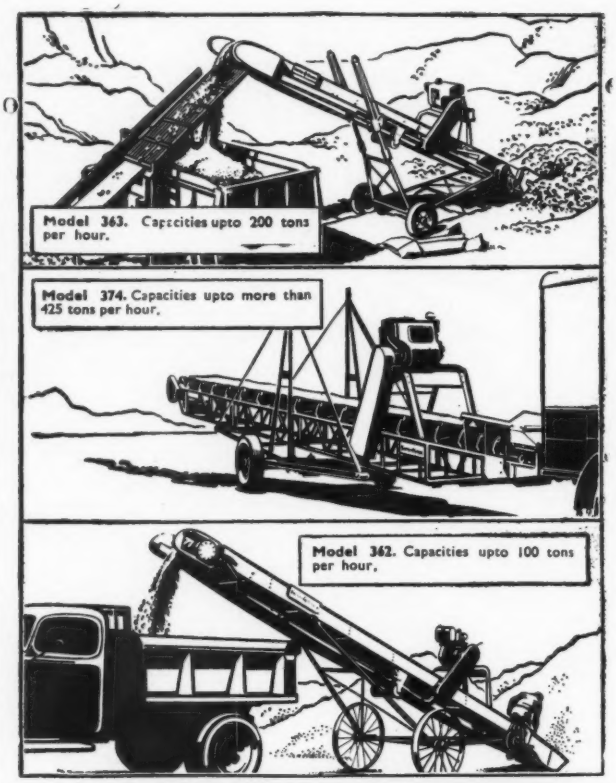
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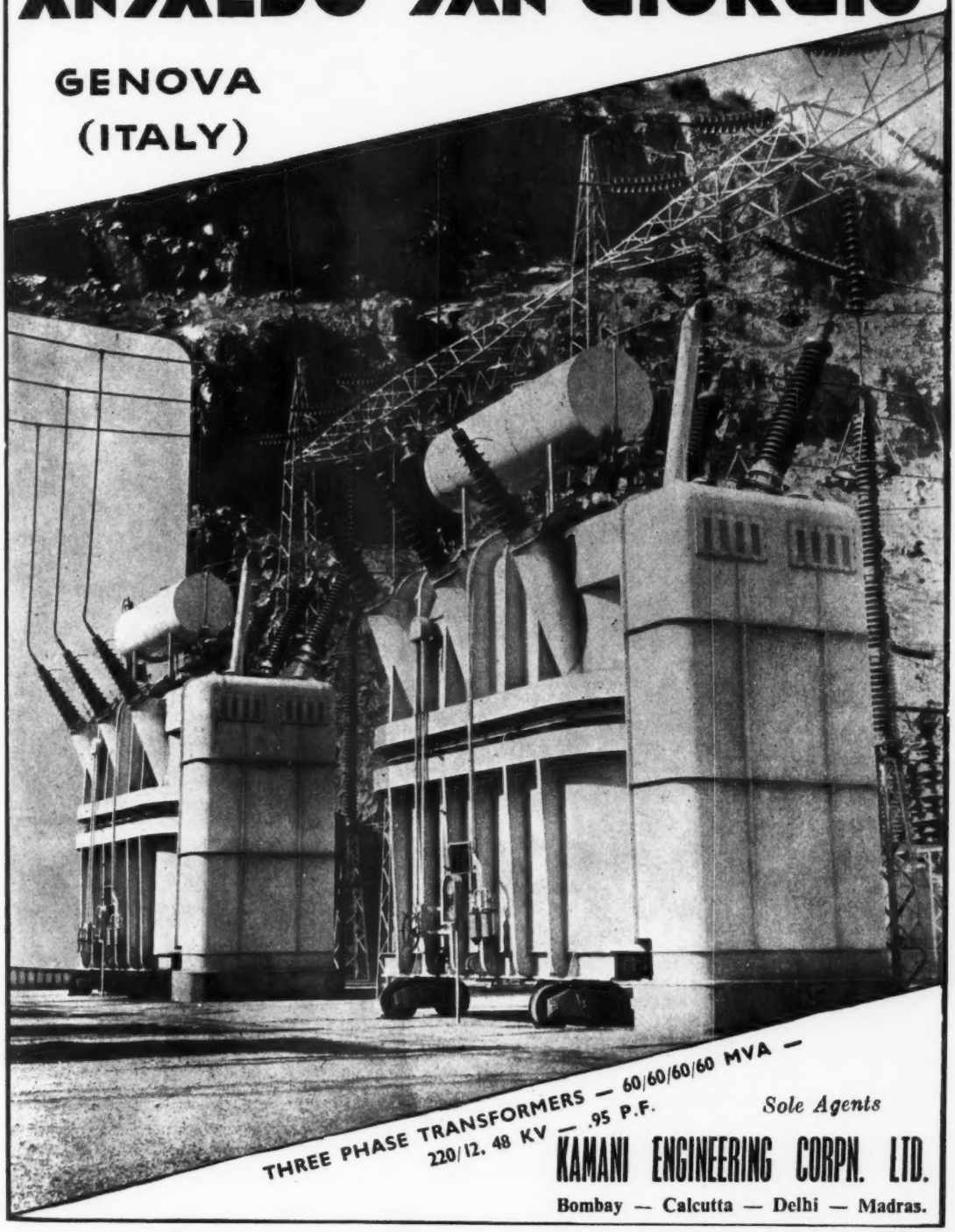

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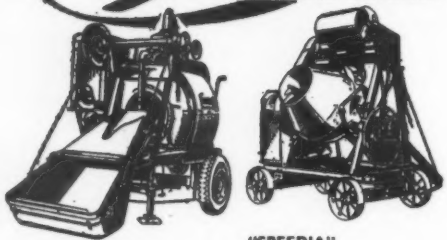

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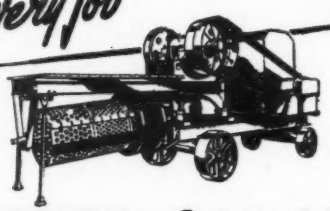

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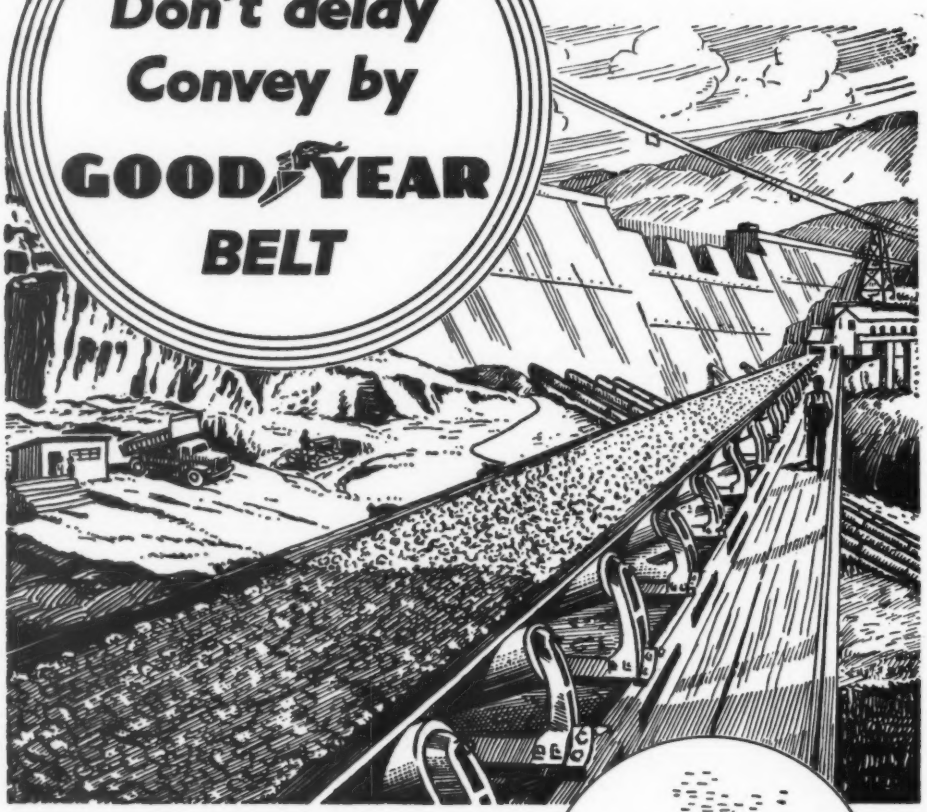

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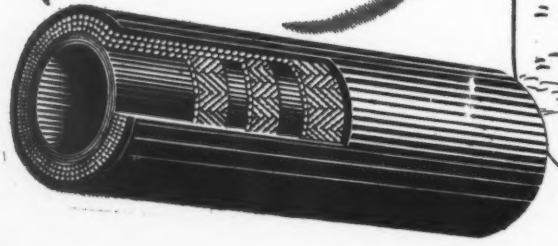

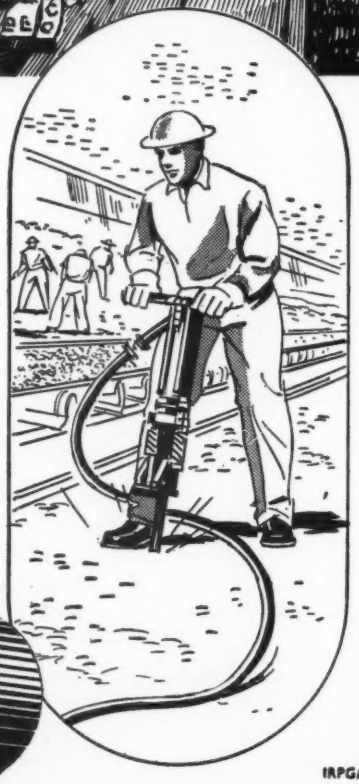

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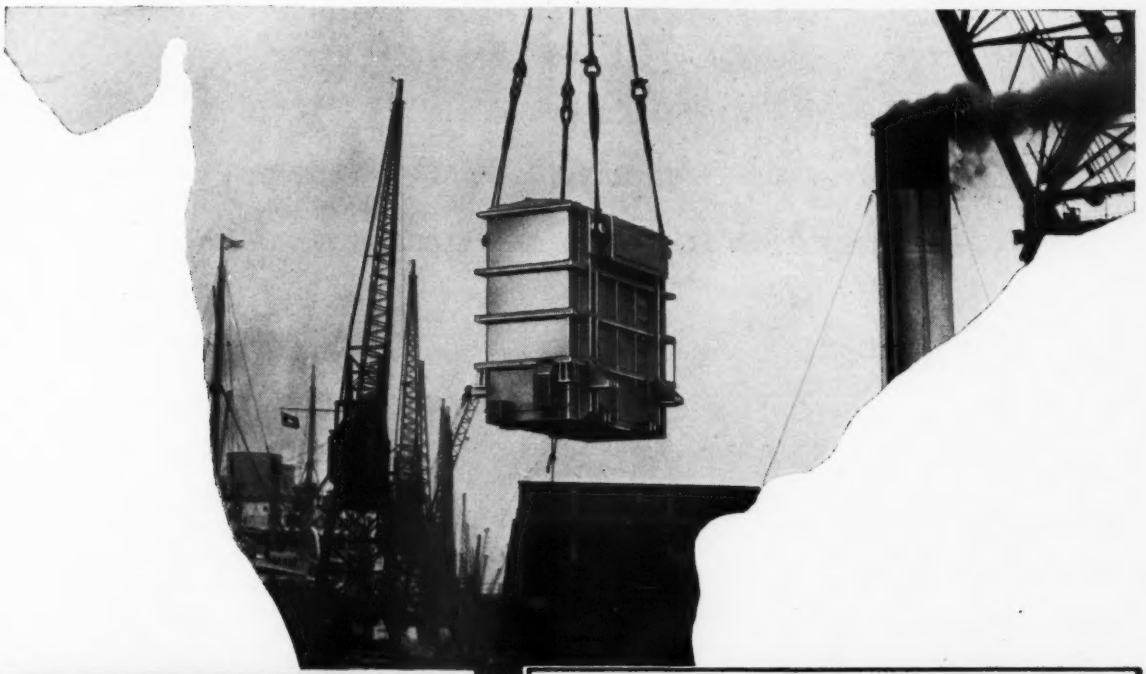

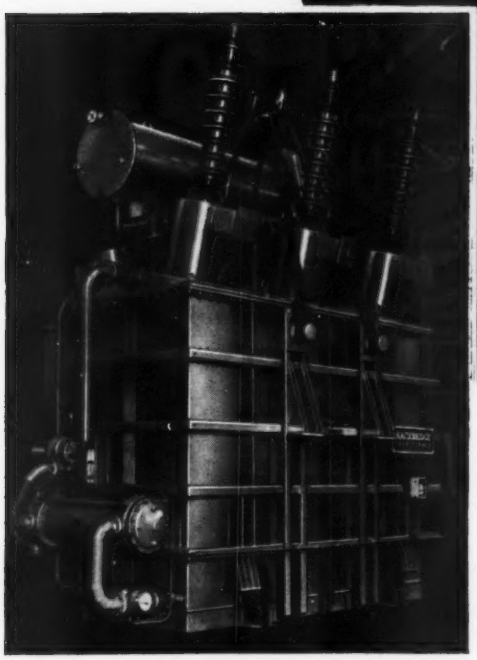

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Editor : K. K. Sinha

P. K. Menon : Mg. Editor

Vol. VI **May, 1956** **No. 5**

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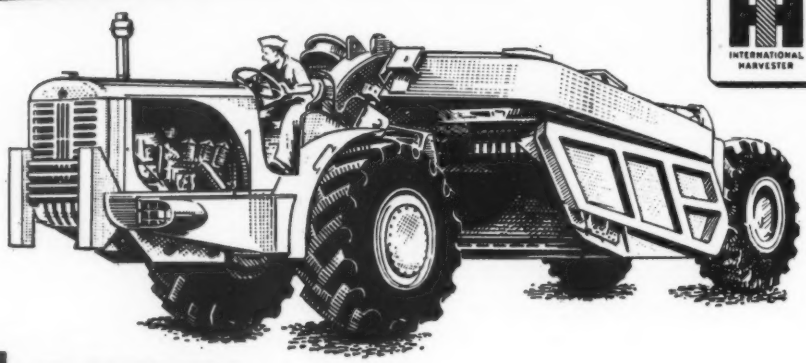

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VOLTAS

Pathri Hydro Electric Power Station

By

N. N. CHAKRAVARTY, *Chief Engineer, Electricity.*
Government of Uttar Pradesh

AUTHOR

With the coming of freedom and a popular government at the helm of affairs, development activities intensified on all fronts and additional 9,300 k.W. were added to the hydel generating capacity of the Ganga Grid by the commissioning of a new Power Station at Mohammadpur in 1952.

Mohammadpur alone, however, could not meet the increased demand which was rising up higher and higher day by day and it was, therefore, decided to augment the supplies by another 160,000 k.W. by constructing Pathri Power Station by-passing the existing Bahadrabad Power Station and abandoning the latter with the commissioning of Pathri Power Station.

The full supply water surface elevation of Ganga Canal dropped by 36 ft. in four falls at Ranipur, Bahadrabad, Salempur and Pathri. The Bahadrabad and Salempur falls were combined when Bahadrabad Power Station with an installed capacity of 4,400 k.W. was constructed in 1934. But this was designed to utilize only half the discharge of the Ganga Canal for generating purposes. Two falls at Ranipur and Pathri were not harnessed and it was, therefore, proposed to replace the existin Bahadrabad Power Station by Pathri Power Station utilizing the full discharge of th> canal and a drop of 30.17 ft. by submerging Ranipur fall and utilizing the Bahadrabad and Salempur falls combined for Bahadrabad Power Station and by partly reducing he fall at Pathri by lowering the crest by 4.62 ft.

The Pathri Power Station has been located near the old Bahadrabad Power Station on a nine-furlongs long diversion of the canal, side-tracking the Bahadrabad Power Station.

Pathri Power Station has an installed capacity of 20,400 k.W. comprising of 3—8000 kVA., 0.85 power factor, 3-phase, 50 cycles, 11000 volts, 125 r.p.m. turbo-alternator sets. The turbines have been manufactured by Messers. J. M. Voith, Germany and are of the Kaplan type with vertical shafts directly coupled to the alternators manufactured by Messrs. Siemens Schuckertwerke, Germany. The power generated is stepped up from 11,000 volts to 66,000 volts through a couple of 12,000 kVA, transformers before being injected into the Ganga Grid.

A full capacity bye-pass channel with automatic gates to maintain constant water level upstream of the Power House has been provided to pass surplus water due to load fluctuations and also the full supply of canal whenever necessary during emergencies.

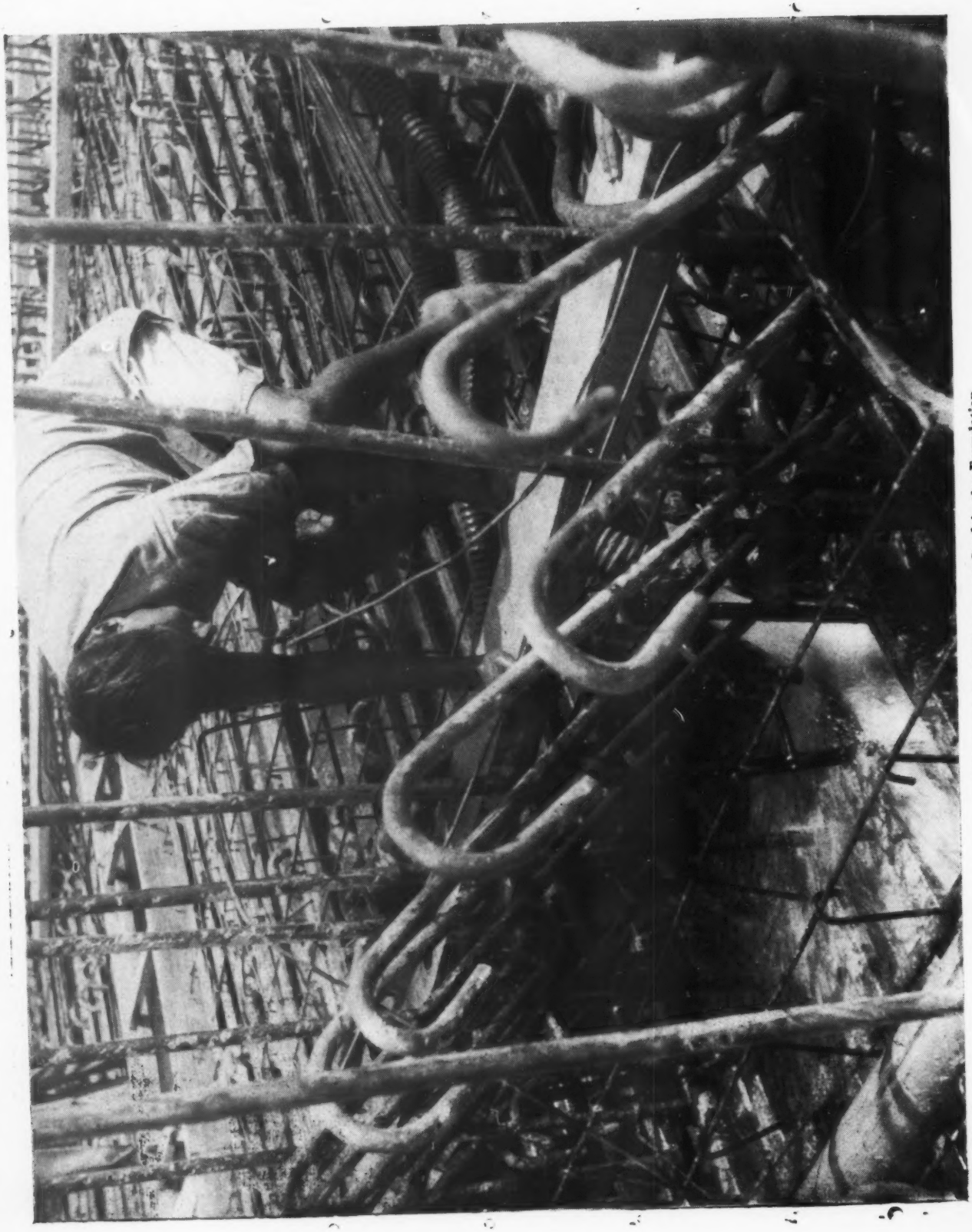
A. *Civil Works*—Work on the project was started in full swing early in 1951 when the excavation of diversion channel was taken up. The problems of design and construction at every stage were intricate and unique. Solid raft 160′×80′ of reinforced concrete had to be laid 60ft. below the terrain level and 32ft below the ground water level. The Power House building rising 100 ft. above the foundation is a monolithic structure of reinforced cement concrete.

The first basket of concrete was laid on 10th April, 1952 and the massive foundation raft involving 900 tons of steel reinforcement and 1,20,000 cft of concrete was laid by the middle of September, 1952, entirely by manual labour.

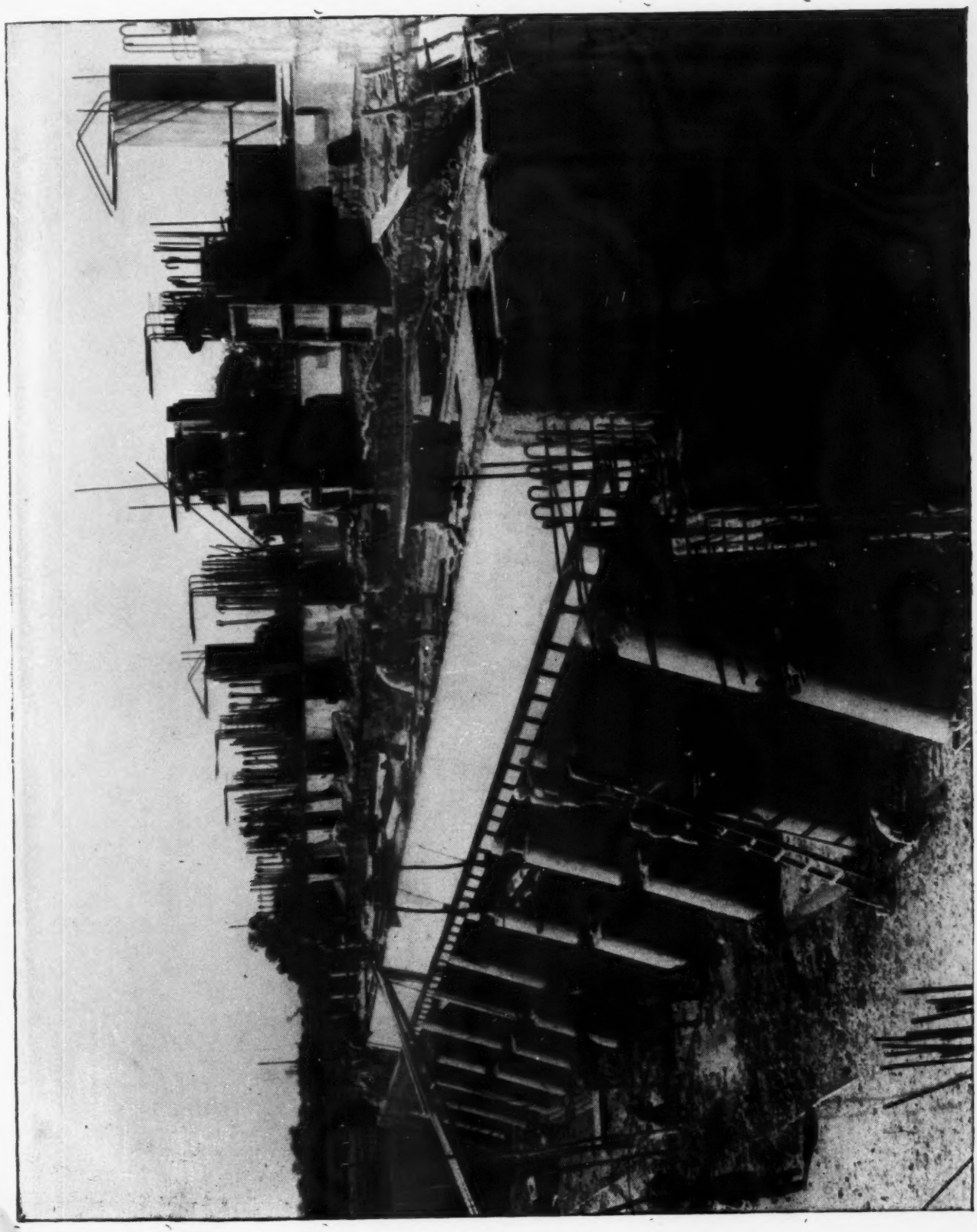
The sub-structure of the power house along with fore-bay and other auxiliary structures were completed almost within one year from the date of commencement of concreting. The following 14 months witnessed the completion of the bulk of power house with all auxiliaries. The diversion works involving 32 lakhs cft. of earth work, 60,000 cft. of concrete, 2 lakhs cft. of boulder pitching and miscellaneous other items were executed within a short period of two weeks when the Ganga Canal was closed in October, 1954.

B. Plant and Machinery—The erection of the plant and machinery was taken up in January, 1954 and as soon as the civil works progressed to a stage permitting the installation of the gantry girders of the Power House crane, the erection work of the crane was commenced and progressed simultaneously with the remaining civil construction works in close coordination. Erection work on the plant and equipment was so planned that work was carried out on all the three units simultaneously with a special consideration for getting the work on turbine no. I completed earlisst. By the end of December, 1954, the erection work on all the machines was in full swing.

The first machine was synchronzed with the grid on the 25th July, 1955 with the second and third machines following on the 18th September and 14th December of the same year respeetively.

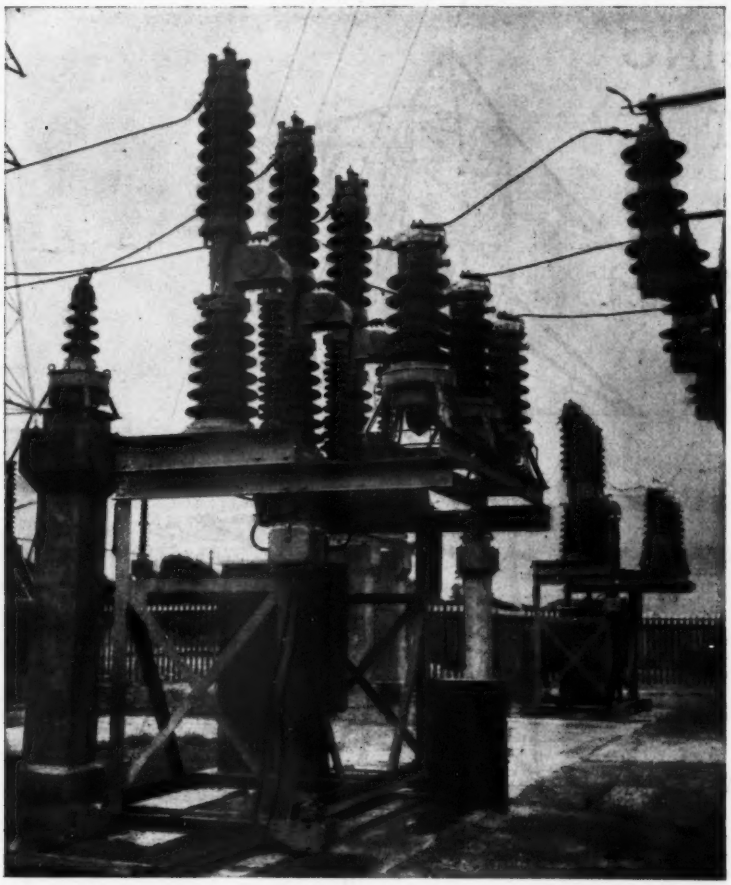


A View of the Reinforcement Steel in the Foundation



Construction works on the Upstream

Bye-pass Channel Construction



66 kV Low Oil Content Circuit Breakers at Bareilly Substation.

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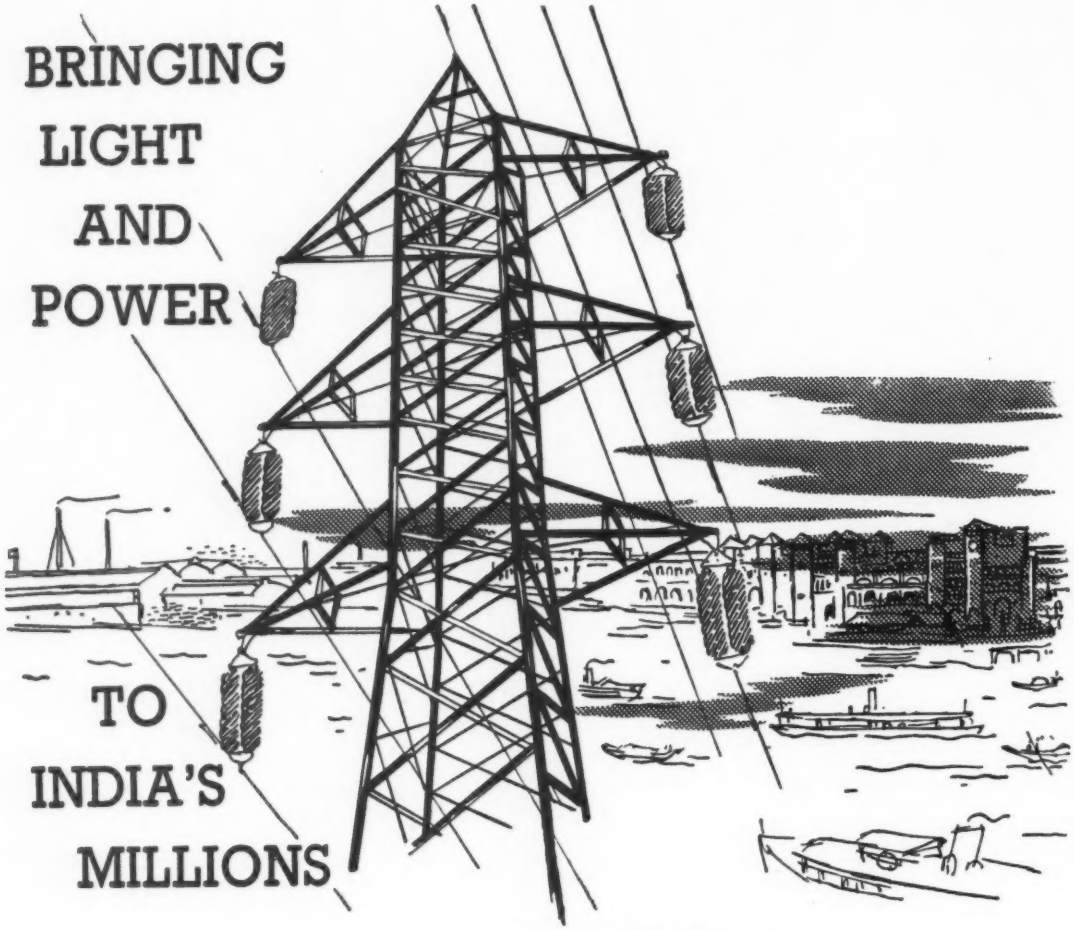

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Special Features of the Plant and Machinery

Umbrella Construction

In this power station, the turbo-alternators are of umbrella type. This umbrella construction reduces the overall cost of the set and also reduces the height of the power station building thereby resulting in saving in the cost of the building.

"Closed Air Circuit Ventilation" with Fire Extinguishing Device

The alternators are totally enclosed type provided with "closed air circuit ventilation" water cooled by air coolers distributed over the circumference of the stator.

The advantages of this type are :

(1) The air being free from dust, etc. the ventilation remains in first class condition due to which life of the machine is increased.
(2) The omission of the air inlet and outlet ducts in the machine hall enables the station to be built on a smaller superficial area and no special arrangements are necessary to control the temperature inside the Power Station.

The fire Extinguishing device comprising a battery of 16 steel cylinders of carbondioxide each containing 66 lb. of gas has been provided for common use on the three alternators. The device is arranged for automatic operation by means of differential protection of the alternator and also for manual operation by push button switch fitted on the alter-nator operating switch board. Thus in case of any fault in the alternator stator winding resulting in a fire, the carbondioxide stored in the cylinders will be discharged atonce into the housing of the respective alternators and the fire shall be extinguished.

High Speed Excitation Electrical Shaft Equipment

The above equipment has been used for supplying the required excitation current to the field of alterators at Pathri Power Station. It consists of :

(*a*) an auxiliary alternator mounted in the main generator below the upper bracket, thus being mechanically coupled with the main generator. It does not effect the total height of the generator set nor does it require any additional guide bearing :

(*b*) the excitation converter set comprising a three-phase asynchronous motor driving the main and pilot exciter. The asynchronous motor is directly connected to the auxiliary alternator through a 3-core cable, which is named as electrical shaft.

In this arrangement, the main and pilot exciters are high speed machines, i.e. of about 750 r.p.m. due to which there is a considerable reduction in size of the exciters and hence the magnetic inertia.

Isolated Neutral of the Alternators

Unlike other power stations of the Ganga Grid, the neutrals of the generators at Pathri Power Station have been kept completely isolated. For detecting the earth fault either in the generator or in the cables, earthing transformers, one set for each 11 kV. busbars, have been provided. These earthing transformers have their 11 kV. windings star connected and the 110 volts winding connected in open delta. The Star point is solidly earthed whilst the open delta point is connected to a loading resistance which can be adjusted for giving enough fault current for the operation of differential protection relays of the generator. The advantage of this system of earthing is that the earth fault current is very low due to which there is practically no damage at the point of fault. This feature is of great importance as the capactiy of the Pathri machines is fairly big.

Trash Rack Cleaning Machine

Great difficulty is experienced at Power Station where the trash racks (or screens) installed in the intake for arresting all the debris from going into the turbines, are cleaned manually. At times so much debris is accumulated at the screen, particularly at power stations like Bahadrabad and Nirgajni that labour is unable to clear off the debris with the result that the load on the machines has to be reduced.

Pathri Power Station being the first station on the canal and of quite a big capacity, an electrically operated track cleaning machine has been installed here.

The machine has also been fitted with an electrical hoist to lift the upstream intake gates and stop logs.

Quick Dropping of Upstream Intake Gates

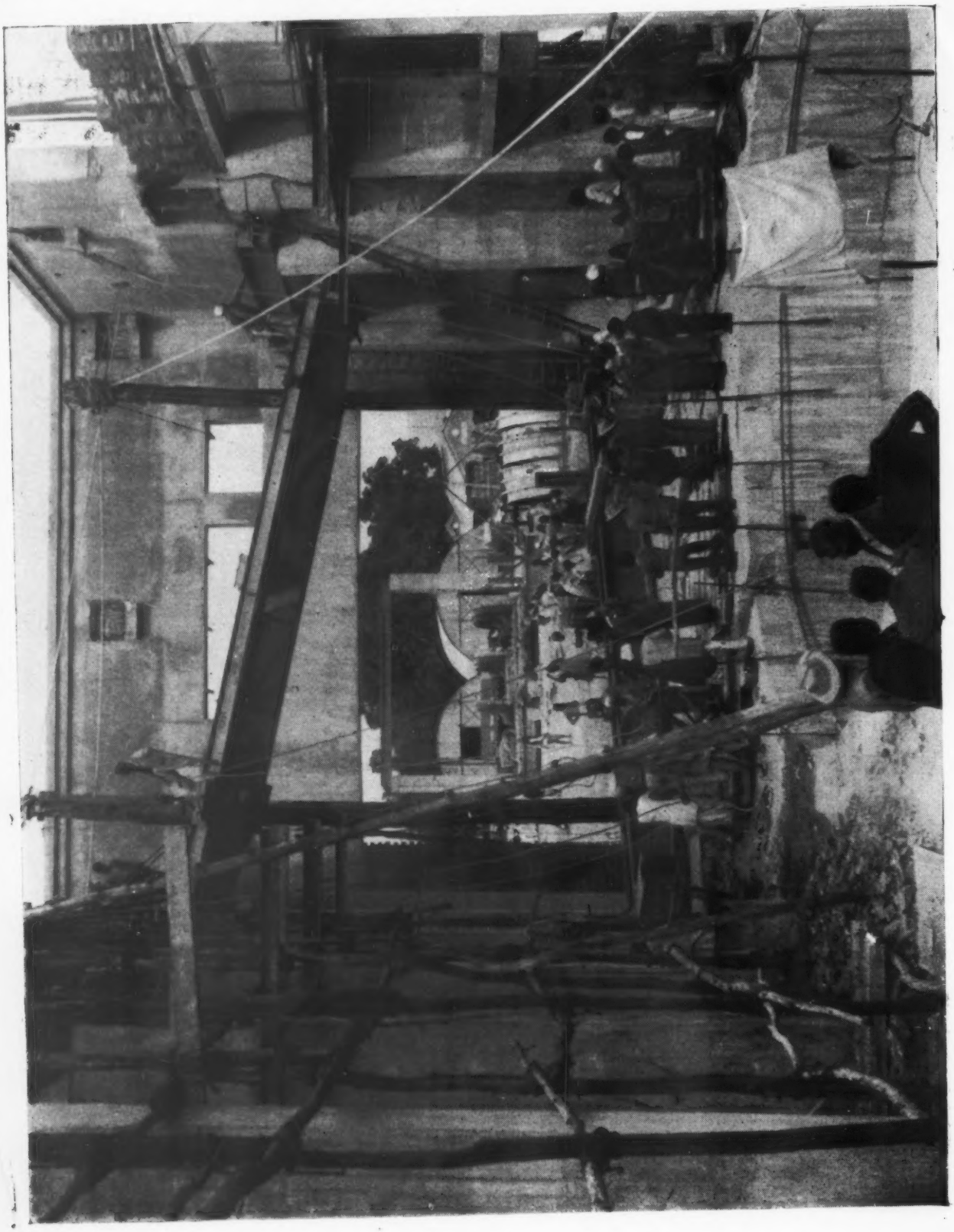
In machines of capacities as big as those at Pathri the quick dropping of upstream intake gates is very important. Therefore, the upstream intake gates at Pathri have been provided with solenoid operated quick release mechanism. Thus the gates can be dropped from the control room itself.

Oil immersed self and forced Air cooled power Transformers

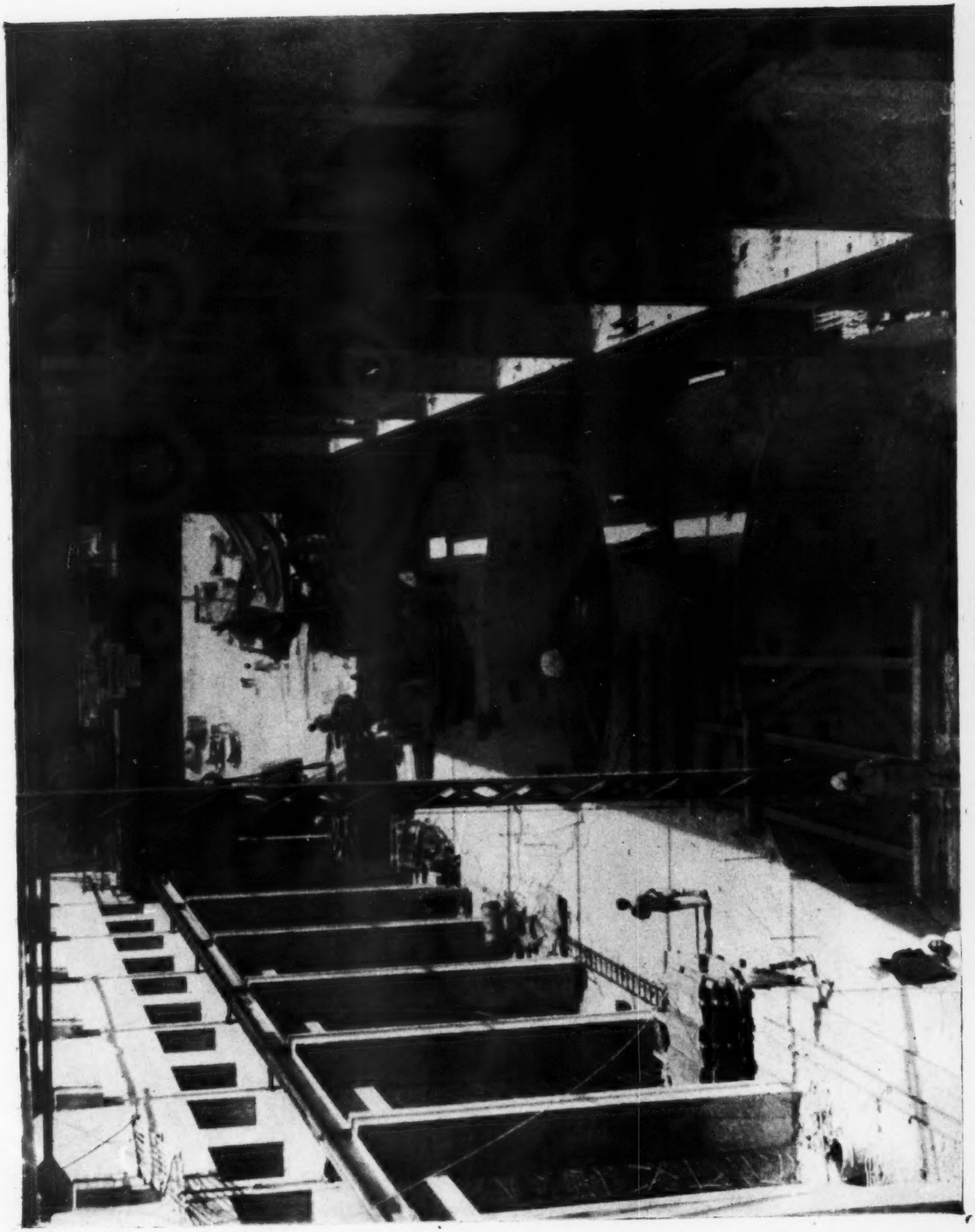
The two 12000 kV. 11/66 kV. power transformers and oil natural cooled up to 60 per cent of the rated output, and forced air cooled for load above 60 per cent of the rated output. For forced cooling, each transformer has been fitted with 10 electric driven fans which are provided with automatic device for starting and stopping in accordance with the requirements of cooling. In this connexion, it is of interest to note that this type of transformer weighs much less than oil natural cooled one and, therefore is, cheaper.

Compressed Air-operated 11 and 66 kV. switchgear

The 11 kV. switchgear comprises Siemens Expansine Circuit Breakers which utilize expansine as the arc quenching medium. Expansine is a solution of water and glycol. The 66 kV. circuit breakers are also of Siemens Expansion type but with insulating oil as the arc quenching medium. All the 11 and 66 kV. circuit breakers together with the isolators are compressed air operated, arranged for remote electrical control. The compressed air is obtained from two electric driven automatic air compressor units. This compressed air operation has the advantage that the

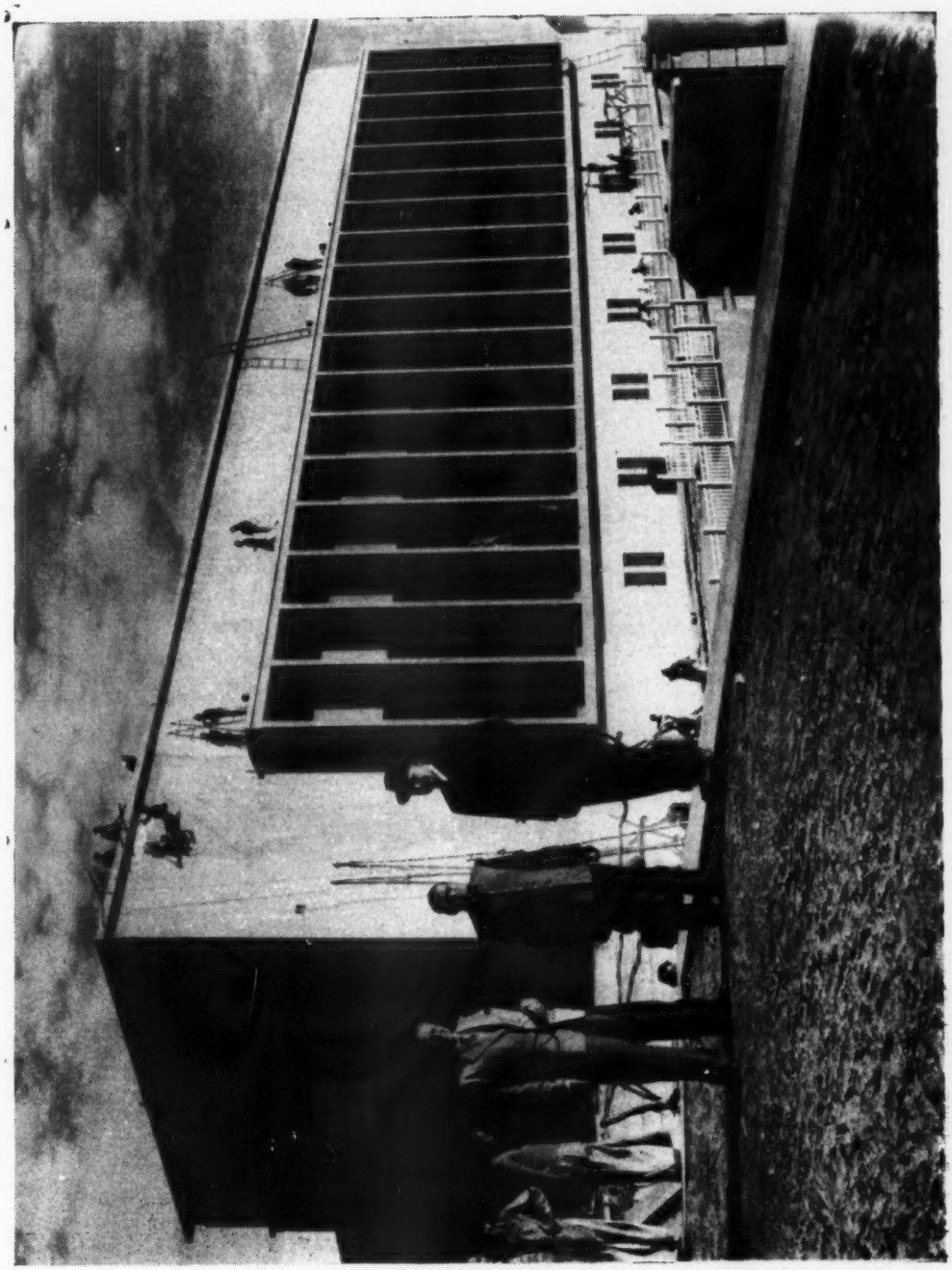


Crane Gantry under Erection

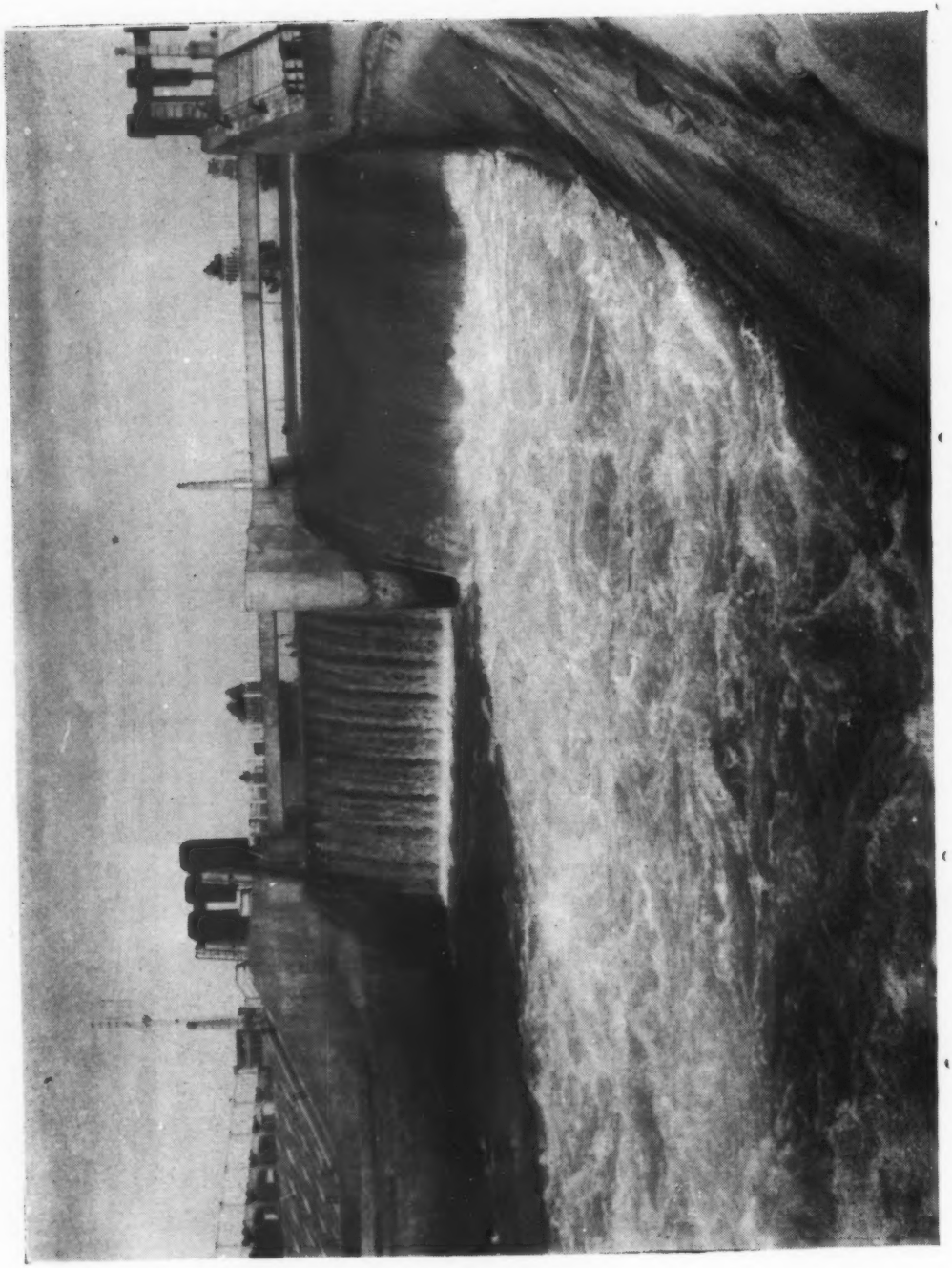


Erection of Machines

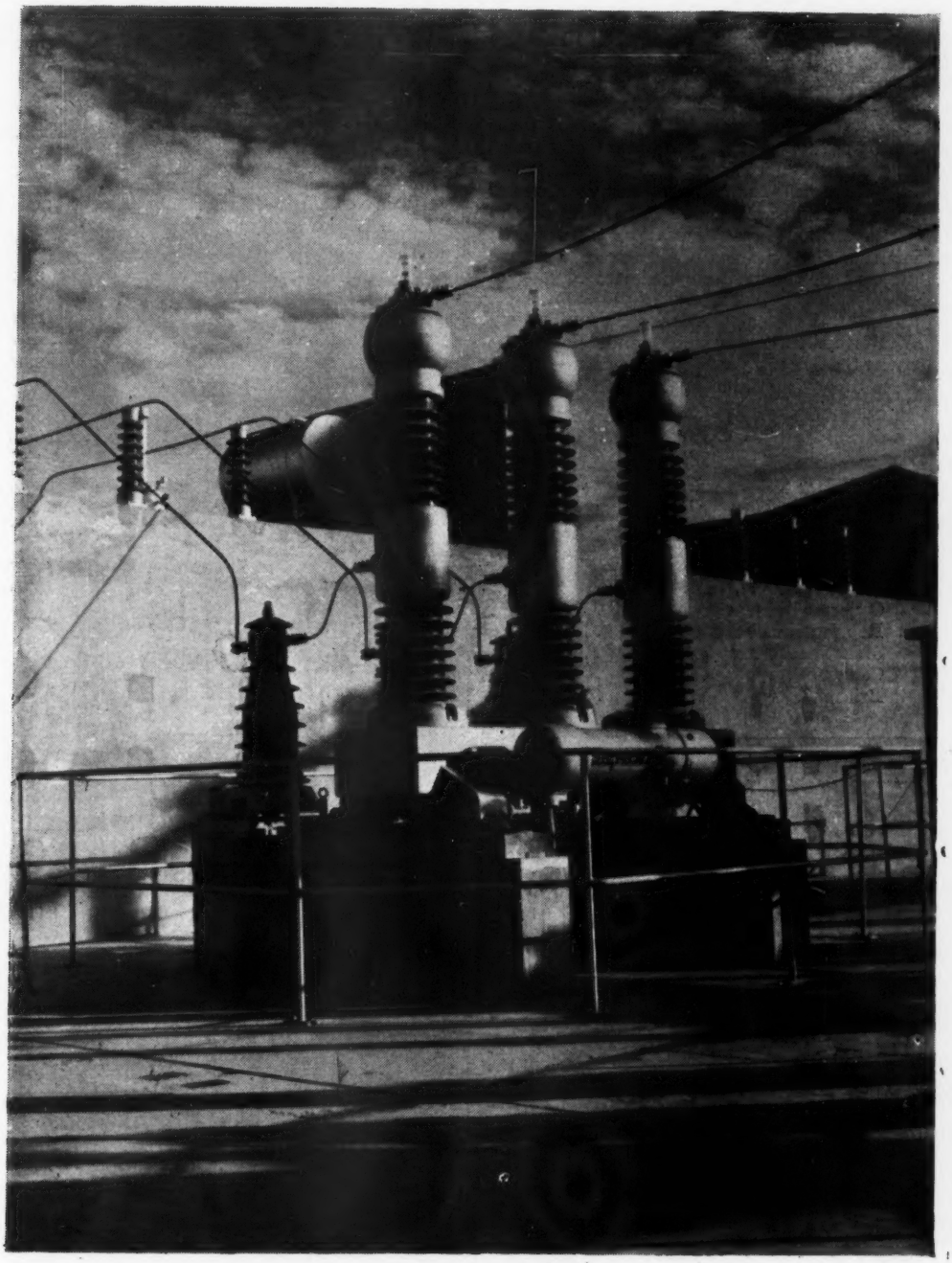
A General View of the Interior of the Power Station



A close view of Power Station Downstream end



By pass Channel with Automatic Gates



66 K. V. Circuit Breaker

circuit breakers and the isolators can be operated even if there is no A.C. supply available.

Financial Aspects

The project is estimated to cost Rs. 2,93,09,158 including cost of plant and equipment. Additional Rs. 1,33,95,000 will be required for transmission lines and sub-station for distribution of power. A gross revenue of Rs. 41,97,210 is anticipated by the sale of energy and an additional profit of Rs. 5.3 lakhs will accrue by saving in the consumption of coal at the interlinked steam stations. Net revenue after deducting cost of running and depreciation of machinery will yield a return of 7.33 per cent on the capital outlay. Allowing an interest of 3½ per cent on the initial cost the net profit will amount a return of 3·83 per cent. on the capital expenditure.

Some Interesting Facts about Pathri Power Station

1. Useful electrical energy made available by the Pathri Power Station per year shall be equivalent to a labour force of 4,25,000 able bodied men working 8 hours a day throughout the year (and without having to be provided with food and clothing).

2. The steel which has been consumed in the construction of Pathri Power Station is sufficient to make a solid steel rod 3/16″ diameter circumscribing the earth along the equator.

3. With the concrete consumed in the project a pipe line of 8″ diameter can be made from Kashmir to Cape Comorin.

4. The cost of generation from Pathri Power Station will be 2.79 pies per unit.

5. During the excavation of tail race, copper and earthenware antiques, estimated to be 3500 years old, were discovered. Archaeological Departent of India considered these finds of great historical importance and carried out some other excavations themselves.

SALIENT FEATURES

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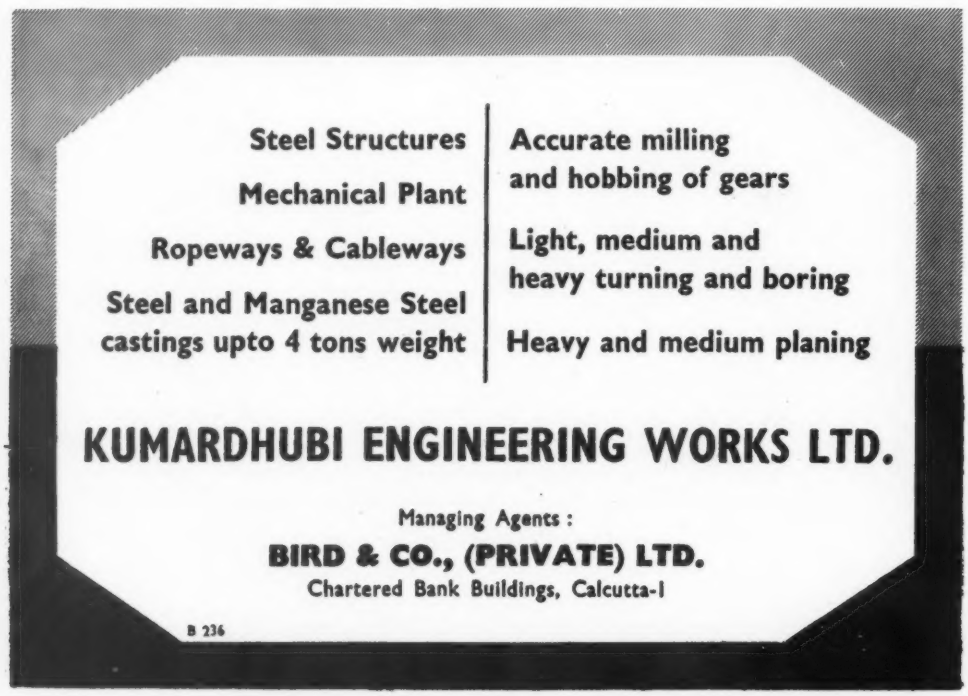
Main Items of Works—		
Earth Works	..	3,00,00,000 cft.
Concrete in Masonry	..	14,50,000 cft.
Reinforcement Steel	..	5,000 tons.
Steel Sheet Piles	..	1,200 tons.
Cement	..	12,500 tons.
Bricks	..	20,00,000 nos.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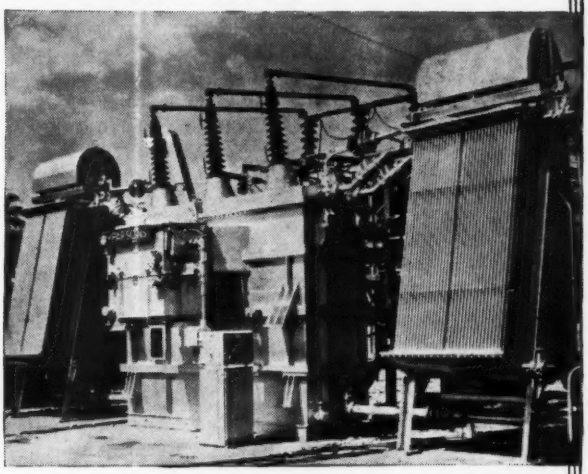
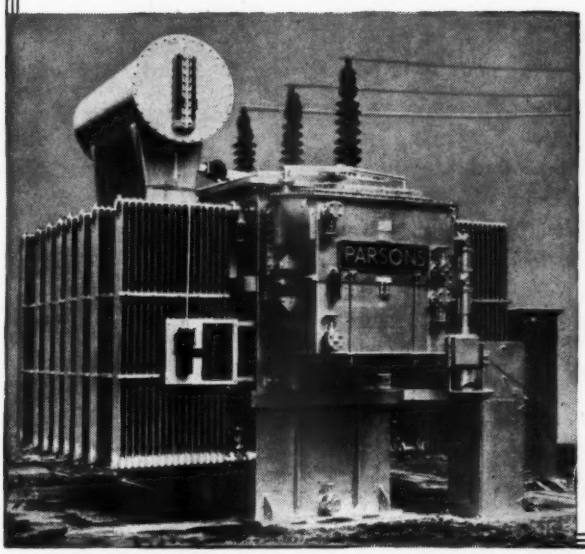


TRANSFORMERS



The illustrations show two types of transformers, both fitted with on load tap changing gear.

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A-55-1.

Report of Ministry of Irrigation & Power-1955-56

The following is a summary of the Report placed by the Ministry of Irrigation and Power, Government of India, before the Lok Sabha.

The Ministry of Irrigation and Power lays down the general policies for the development of irrigation and power and for flood control measures, renders technical assistance to the States in the planning and execution of projects and watches the progress of work and expenditure against the loans sanctioned. The Ministry also co-ordinates the requirements of men, materials and equipments for these projects.

Of the total outlay in the First Five-Year Plan, Irrigation and Power Projects were responsible for no less than 28 per cent. amounting to Rs. 661 crores. To the Ministry of Irrigation and Powers falls the task of supervising the implementation of these schemes and ensuring that the optimum value is obtained for this large investment.

The increasing tempo of work on irrigation, power and flood control projects and the work relating to the screening of schemes for inclusion in the Second Five-Year Plan necessitated the strengthening of the Secretariat. Proposals for additional staff were scrutinised by the Special Reorganisation Unit of the Ministries of Home Affairs and Finance, and additional posts of 1 Deputy Secretary, 1 Under Secretary and ancillary staff required to man an additional section were sanctioned. An Honorary Adviser for Public Cooperation was appointed in January, 1956, to organise and co-ordinate the work executed through public co-operation on river valley projects.

A post of Internal Financial Adviser of the rank of Deputy Secretary was also created in consultation with the Ministry of Finance as an experimental measure from the 25th May, 1955. This arrangement enables the Ministry to avail itself of expert financial advice at all times and to associate the financial aspect of every scheme in its scrutiny right from the very beginning. This procedure ensures that sanctions are not subsequently delayed by reason of inadequate financial scrutiny. The Internal Financial Adviser also keeps a watch over the progress of expenditure.

The strength of the Secretariat (excluding the staff temporarily sanctioned for Canal Water Dispute work) is 30 Gazetted Officers, and 241 non-Gazetted. A Budget allotment of Rs. 11.43 lakhs was made for the year 1955-56, but in view of the increasing work, the Ministry had to ask for an additional grant of Rs. 6.87 lakhs.

Legislation

During the year under review, the following legilsative measures were undertaken :—

(*i*) *The Inter-State Water Disputes Bill*, 1955.—Under Article 262 of the Constitution, Parliament is empowered to provide by law for the adjudication of disputes or complaints with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley. In pursuance of this Article the inter-State Water Disputes Bill, 1955, providing for the adjudication of disputes relating to the waters of the inter-State rivers and river valleys, was introduced in the Rajya Sabha on the 3rd May, 1955, and passed by that House on the 12th December, 1955. It will come up for consideration in Lok Sabha.

(*ii*) *The River Boards Bill*, 1955.—Item 56 of List I of the Seventh Schedule of the Constitution casts the responsibility for the regulation and development of inter-State rivers and river valleys on the Central Government. Hitherto there was no machinery or agency through which the Centre could discharge this responsibility. The River Board Bill 1955 is intended to remedy this lacuna. The Bill provides for the establishment, in consultation with the State Governments concerned, River Boards whenever the Central Government considers that the setting up of such Board is necessary for the regulation and development of inter-State rivers and inter-State river valleys. The Bill was passed by the Rajya Sabha on the 9th May, 1955 and will come up for consideration in the Lok Sabha.

(*iii*) *The Electricity (Supply) Amendment Bill*, 1956.—The Electricity (Supply) Amendment Bill, 1955, (Bill 50 of 1955) was introduced in in the Lok Sabha on the 26th September, 1955. The object of the Bill is to remove anomalies and difficulties which have come to notice in in the working of the Electricity (Supply), Act, 1948. The Bill also provides for some consequential amendments and certain other minor clarifications.

Canal Water Dispute

On the 4th May, 1948, the Governments of India and Pakistan entered into an agreement by which India was progressively to diminish the supply of waters to Pakistan canals as Pakistan tapped alternative sources of supply. Not much progress could, however, be made in the implementation to this agreement till towards the end of 1951 when the President of the International Bank for Reconstruction and

Development suggested that the Bank would be prepared to lend its good offices in resolving the dispute. The two Governments accepted in March, 1952 the proposal of the World Bank that a Working Party should be set up consisting of engineers of India and Pakistan who would be assisted by engineers of the Bank, with the object of preparing, for the consideration of the two Governments, a comprehensive plan for the development of the water resources of the Indus region so that the river supplies effectively available to each country would be increased substantially beyond what they had ever been.

The initial meeting of the Working Party was held in the Office of the World Bank at Washington in May/June 1952. The second meeting was held in December, 1952 to January, 1953, partly in Karachi and partly in New Delhi. The object of the meeting was to exchange studies already conducted by India and Pakistan. The remaining studies were exchanged at Lahore on February 24, 1953, and at New Delhi on March 18, 1953.

The final meeting of the Working party was held in Washington from September 8, 1953. The technical experts of India and Pakistan tried for almost five months to prepare an agreed plan. These efforts did not, however, succeed. On February, 5 1954, the Bank, finding that further discussions were not likely to prove fruitful, presented a proposal to the Working Party which, in its view, could produce a fair and economic result for both the countries. The salient features of the Bank Plan are as follows :

The entire flow of the Western rivers (the Indus, the Jhelum and the Chenab) would be available for the exclusive use and benefit of Pakistan, and for development by Pakistan, except for the insignificant volume of the Jhelum flow presently used in Kashmir.

The entire flow of the Eastern rivers (the Ravi, the Beas and the Sutlej) would be avaialbe for the exclusive use and benefit of India, and for development by India, except that for a specified transition period India would continue to supply from these rivers, in accordance with an agreed schedule, the historic withdrawals from these rivers in Pakistan.

The transition period would be calculated on the basis of the time estimated to be required to complete the link canals needed in Pakistan to make transfers for the purpose of replacing supplies from India. A temporary cooperative administration would be needed to supervise the carrying out of the transitional arrangements.

Each country would construct the works located in its own territories which are planned for the development of the supplies. The cost of such works would be borne by the country to be benefited thereby. Although no works are planned for joint construction by the two countries, certain link canals in Pakistan would, as stated above, be needed to replace supplies from India. India would bear the costs of such works to the extent of the benefits to be received by her therefrom. An apropriate procedure would be established for adjudicating or arbitrating disputes concerning the allocation of costs under this principle.

While the Government of India generally accepted the Bank proposal, it was not accepted by Pakistan. The talks, therefore, ended in a breakdown. The Government of India, however, informed the Bank of their readiness to consider new arrangements for working out a comprehensive plan on the basis of the Bank proposal as soon as Pakistan accepted it. They also offered to enter into an agreement for a transitional period which would enable developments to proceed in both countries on an agreed schedule as envisaged in the Bank Proposal.

After a further exchange of views with the two Governments, the Bank extended an invitation to the Prime Ministers of India and Pakistan to resume discussions for the purpose of working out, without commitment, and for consideration by the two Governments, a detailed engineering plan for the use of the Indus waters, taking the division of waters proposed by the Bank as a starting point. The two Governments accepted the Banks' invitation and discussions were resumed with effect from December 6, 1954, in Washington, on the basis of the new terms of reference proposed by the Bank. As a result of the resumed discussions, two agreements between the Governments of India and Pakistan for *ad hoc* Transitional Arrangements for Kharif 1955 and Rabi 1955-56, were signed on the 21st June and 31st October, 1955 respectively. In pursuance of these agreements, Pakistan has been conveying limited supplies from the Western rivers through the link canals in Pakistan in replacement of supplies received from the Eastern rivers.

Owing to the unprecedented floods in October 1955, extensive damage was caused including link canals, in West Pakistan. Similar damage was caused on our side also. At the request of the Government of Pakistan, a team of Bank Engineers, and a delegation of Indian Engineers visited West Pakistan from 26th November to 11th December, 1955, with a view to surveying and assessing the extent of damage caused to the irrigation works, and to determining rehabilitation priorities for repairs to them. The report submitted by the Bank Engineers to the Bank is under consideration by the Bank and the Indian and Pakistan Delegations now in Washington.

The negotiations towards the preparation of a 'comprehensive' plan are still going on in Washington and are expected to last till the 31st March, 1956.

Flood Control measures in the Eastern regions of India and Pakistan

In August 1955 the Prime Minister of Pakistan suggested that the Governments of India and Pakistan suggested that the Governments of India and Pakistan should cooperate in a common endeavour for the control of floods in the Eastern regions of India and Pakistan. This suggestion was welcomed by the Government of India and a team comprising four senior engineers visited Karachi in September 1955 for preliminary discussions regarding flood control measures in East Pakistan. As a result of these discussions, the Government of India agreed to supply relevant data and give flood warnings by wireless during the monsoon to the East Pakistan Government. Further talks between the two Governments are likely to be held at Ministers' level.

CENTRAL WATER AND POWER COMMISSION

The Commission is responsible for initiating and coordinating schemes for multi-purpose river development and preparing integrated plans for thermal power development, transmission and utilisation of electric energy and tackling the flood problem. The Commission consists of a Chairman and two Members for the Water Wing and two Members for the Power Wing. It is assisted by two Chief Engineers who are in charge of the Flood Wing.

With the establishment of the Flood wing, there has been considerable increase in the scope and activities of the Commission. For the effective discharge of its functions, the Water and Flood Wings of the Commission have been divided into the following Directorates :—

Water Wing

1. Administration, Co-ordination and Information.
2. Technical Examination.
3. Waterways, Irrigation and Navigation.
4. Dams.
5. Canals.
6. Research.
7. Plant and Machinery.

Flood Wing

1. Flood Control Design.
2. Hydrology and Statisties.
3. Silt and Construction materials.
4. Investigations.

A review of the activities of the three Wings is given below :—

Water Wing

Administration, Co-ordination and Information Directorate

International Conferences.—Shri Kanwar Sain, Chairman, Central Water & Power Commission, attended the International symposium on arid lands held in the U.S.A. in April/May, 1955.

An Indian delegation under the leadership of Shri M. S. Thirumale Iyengar, Chief Engineer, Hirakud Dam Project, was sent to Paris to participate in the 5th International Congress on Large Dams. The other members of the delegation were Dr. K. L. Rao, Chief Engineer (Floods, Planning and Design) and Dr. R. C. Hoon, Director, Central Water & Power Commission.

Shri P. R. Ahuja, Superintending Engineer in the Commission, attended the regional technical conference of the Bureau of Flood Control and Water Resources Development held at Bangkok in September, 1955.

Shri D. V. Joglekar, Central Water & Power Research Station, Poona, attended the general meeting of the International Association of Hydraulic Research held at Delft (Netherlands.)

Deputations Abroad.—Shri Kanwar Sain, Chairman, and Shri M. Hayath, Member, Central Water & Power Commission, visited the U.S.S.R. from 31-5-55 to 6-7-55 in connection with the study tour arranged under the auspices of the United Nations Technical Assistance Administration.

Training Abroad.—The candidature of Sarvashri R. H. Sainani, B. T. Anandasagar and S. V. Rao for training under the T.C.M. has been approved. These officers are expected to leave for the United States of America shortly.

The UNESCO have offered a scholarship for one of the officers of the Central Water and Power Research Station, Poona for training in Ship Model Testing. The selection of the officer is in hand.

Training of foreign engineers in India.—The United Nations sponsored one candidate, Mr. Robert F. Camacho from the British Guiana, for training in India in connection with the water resources development. He was in India from the end of August, 1955 to the end of October, 1955. Training facilities were arranged for him in the various river valley projects, such as Bhakra Nangal, Hirakud Dam, D.V.C., and in the Research Stations at Amritsar and Poona.

Mr. Otto Shud Wetzell, an Agricultural Engineer from Peru, who came to India under the UNESCO Fellowship Scheme on arid zones, was given training in the principles and practices of arid zone hydrology followed in India.

National Register.—The National Register of Irrigation and Power Engineers containing information in respect of all the States of the Indian Union except the States of Madras, Madhya Pradesh and Jammu and Kashmir, was compiled on the basis of information received upto June, 1955. The information in respect of these three States is being collected.

Publication and Publicity.—The more important of the publications brought out during the year 1955-56 are :—

(*i*) Main Report and Suppelmentary Report of the Construction Plant and Machinery Committee.
(*ii*) C.W. & P.C. Triennial Administration Report (1950-53).
(*iii*) Proceedings of the Irrigation and Power Seminars :—
  (*a*) Nangal—Vol. III.
  (*b*) Roorkee—Vols. I & II.
  (*c*) Srinagar—Vol. II and emergency copies of Vol. I.
(*iv*) C.W. & P.R.S. Technical Report Annual, 1952.
(*v*) An illustrated pamphlet entitled "What Physics Division can do for you".

The publication "Snow Surveys in the Himalayas" with a special cover design, and an illustrated pamphlet "Engineering Museum", are in the final stages of printing.

Publicity.—The monthly journal entitled "Bhagirath," which was started in June, 1954 continued to be published during the year 1955-56. A quarterly Power Supplement was added to it with effect from May, 1955. The main articles published in the journal were widely reproduced in Indian and English dailies and periodicals.

A guide book for the D.V.C. projects was prepared

with a view to encouraging visits to the projects by tourists, Indian and foreign. Similar guide books for other major river valley projects and posters are under preparation.

Technical Examination Directorate :—

This Directorate carried out examination of 23 projects included in the First Five Year Plan and 17 projects recommended for inclusion in the Second Five Year Plan, as detailed below :—

Sl. No.	*Plan period*	*No. of Project received including balance from previous years*	*No. of projects scrutinised*	*No. of projects under scrutiny*
1.	First Plan	30	23	7
2.	Second Plan	38	17	21
	Total	68	40	28

The more important among the projects scrutinised for inclusion in the Second Five Year Plan are :—

1. Vir, Mula, Khadakwasla and Girna Projects in Bombay State.
2. Hemavathi and Kappini Projects in Mysore State.
3. Purna Project in Hyderabad State.
4. Sirhind Feeder and Gurgaon Canal in Punjab.
5. Kangsabati Project in West Bengal.
6. Salandi Project in Orissa.
7. Tawa Project in Madhya Pradesh.
8. Vamsadhara Project in Andhra.

Besides the scrutiny of projects, the following important items of work were attended to by this Directorate :—

1. Comments were offered on the draft plans for river valley projects prepared by the various States for discussion at the meetings of the Working Groups set up by the Planning Commission.

2. Notes on the requirements of technical personnel, materials, foreign exchange etc., for projects proposed to be included in the Second Five Year Plan were prepared.

3. Statements for the phasing of expenditure on projects under the Second Five Year Plan prepared by the Planing Commission were scrutinised in the light of the actual achievement by the States, their capacity, etc.

4. Maintenance of "Control Room". Monthly and quarterly progress reports of projects under execution were examined. Note-volumes for irrigation and power projects in 12 States were brought up-to-date for circulation in connection with the meetings with the M.Ps. Index maps of invididual States showing (i) projects under execution under the First Plan, (ii) projects already under operation and (iii) projects proposed for the Second Plan, were prepared.

Waterways, Irrigation and Navigation Directorate

Irrigation—Technical Examination of Projects.—The irrigation aspects, namely, intensity of irrigation, duty, crop pattern, water rates, betterment levy, etc. of thirty-seven projects prepared by the State Governments were scrutinized.

Assessment of Irrigation Potential.—1. *Importance of Assessment of Irrigation Potential.*—The lack of an appraisal of the extent of land and water resources available in India for irrigation in different basins was keenly felt during the selection of schemes for the First Five Year Plan. A programme for the assessment of the irrigation potential of the various regions of the country was therefore drawn up. The assessment is being made under the following three categories :—

(*a*) The total water and land resources available for irrigation in the various basins and regions;
(*b*) The extent to which the resources are at present being utilised ;
(*c*) The possibility of the optimum utilisation of the balance for irrigation.

For the purpose of this study, India has been divided into the following zones :—

(*a*) West Flowing Rivers of India.
(*b*) East Flowing Rivers of India.
(*c*) The Indus River System in India.
(*d*) The Ganga River Basin.
(*e*) The Brahamputra River Basin.
(*f*) The River Basins of Andaman and Nicobar Islands.

In zone (a), draft reports have been prepared for the river-basins of Travancore-Cochin, the West flowing rivers of Madras and Bombay State below the Tapi river, and the Narbada and Tapi basins. The work relating to the basins of the rivers flowing into the Arabian Sea above the Narbada and below the Indus is in progress.

In zone (b) the report for the Cauvery and Tambraparni basins are ready. The studies in the Mahanadi, Godavari, Krishna and Pennar basins are in progreess.

The work in zone (c) is connected with the settlement of the Canal Water Dispute with Pakistan.

In zone (d), the irrigation potential of the Chambal basin has been worked out and the report sent to the State Government for their comments. The work is in progress in the remaining basins in this zone and in zones (e) and (f).

Waterways.—The waterways reports on the Sabari, the Indravati, the Beas and the Chambal rivers are being recast. The report on the Gandak river has been completed and sent to the Government of Bihar for their comments.

The Irrigation Review, which was being annually published till 1938-39, has not been issued since that year. It is now proposed to issue the reviews for the years 1939-40 to 1953-54, starting with the review for 1953-54, working backwards. The draft reviews for 1952-53 and 1953-54 have been prepared and sent to the States for scrutiny and comments.

Navigation.—The preparation of a navigation report in respect of the Mahanadi river is in hand. The Government of Madras were advised regarding the possibility of greater use of minor ports in the southern districts of that State. While offering comments on the Dihang Dam Project prepared by the Government of Assam for the development of power, the navigational possibilities of the river were brought to the notice of the State Government.

Investigation for Pardip Port in Orissa.—The hydrographic surveys and navigational investigations for the development of the Pardip port on the Mahanadi mouth in Orissa were continued. The data collected are being forwarded to the Central Water and Power Research Station, Poona, for model tests which have been taken up this year. It will take about two years to complete the experiments.

Directorate of Dams

Detailed drawings of the main dam, the powerplant and the gates of the Hirakud Dam Project, the penstock and the spillway gates of the Koyna Hydro-electric project, and the weir, intake structure and surge tank of the Umtru Hydel Project were prepared. The designs of the power dam, penstock etc., of the Gandhi Sagar Dam (Chambal Project) and specification drawings of the Tungabhadra Power Plant were also prepared.

The estimates for the Hanumannagar Barrage, and the specification drawings for the Ukai Dam, Gora Dam and Broach Irrigation Scheme were finalised.

Advice was given on design problems to Uttar Pradesh regarding Rihand Dam, to Madhya Pradesh regarding Moorum Nullah Tank and to Andhra and Hyderabad regarding Bhira Power Plant and construction material for Nagarjunasagar Project.

Directorate of Canals

The work relating to the design of structures for the Kakrapar Project was completed in September, 1955. Work relating to the Chambal Project is in hand.

Type designs.—The manuals on "Type design of falls' and 'Field data required for the design of canal structure', have been drafted and will shortly be circulated for comments. The manuals on 'designs of bridges and channels' and 'cross-drainages and their regulation' are under preparation.

Central Water and Power Commission Research Station, Poona.—During the year under review, the Station continued to maintain a high standard of research with the co-operation of the different research divisions. The more important recommendations which were made by the Research Stations and which are being implemented, are :—

(*a*) Location, alignment and number of spurs for the protection of Dibrugarh town from erosion by the Brahamputra ;

(*b*) Recession of the Fulta point on the Hooghly river for improving the navigation of Calcutta Port ;

(*c*) Designs for earth dams in Bhopal State based on the field and laboratory investigations.

Some of the other important problems on which the various divisions of the Research Station were engaged during the year are the Kosi Project, the Sone River bridge, erosion in the Cochin Coast, the Kandla harbour, the hydraulic structure of Koyna Project, the photoelastic studies on Bhakra dam foundations, the reclamation of soils in Rajasthan and the studies on 'rainfall' and 'run-off.

Among the new problems of major importance undertaken by the Research Station are the prevention of erosion of Dalaighai area of the Mahanadi, the development of Porbandar and Veeraval and Bombay harbours, soil surveys and geophysical investigations for irrigation projects in Rajasthan, geophysical investigations in the Punjab and the standardisation of photoelastic studies.

On the construction side, the main activities were the covering of the 500 ft. long navigation tank at a cost of Rs. 1 lakh, the laying of the inter-communication road in the newly developed area costing Rs. 35,000 and the construction of several model sheds costing over Rs. 25,000. The navigation tank, the first of its type in South-East Asia, was opened by the Prime Minister on the 4th June, 1955.

The services of Dr. H. F. Nordstrom, an expert in navigation, have been secured under the UNESCO. He has started training Indian personnel. Shri M. N. Venkatesan, Chief Research Officer (Soil Engineering and Materials) has been selected as an expert on soil mechanics under the Colombo Plan to assist the Government of Burma in establishing a soil laboratory in Burma and to train Burmese Engineers in handling earth dam projects.

Training was given during the year under report to officers of the West Bengal and Assam Research Stations.

Plant and Machinery Directorate

Under the United States Technical Cooperation Aid Programme to India, assistance in the shape of equipment worth about Rs. 3.3 crores has been received for river valley projects.

A Centre for the training of operators and machanics, on the operation and maintenance of heavy earth-moving equipment was started at Kotah (Chambal Project).

Projects under Investigation

I. *Assam.*—(a) *Kopili Projects.*—Preliminary reconnaissance surveys on a multi-purpose project on the Kopili river for irrigation of 2.52 lakh acres generation of 1.25 lakhs K.W. of power and for providing flood control, were completed and a preliminary project report has been prepared.

(b) *Nao Dihing Project.*—Preliminary reconnaissance report for multi-purpose project on the Nao Dihing river for flood control, power generation of 65,000 K.Ws. and for facilitating navigation in the Dihing river was prepared.

(*c*) *Barak Project.*—Preliminary reconnaissance sur-

veys are in progress on the Barak river. Surveys for for dams sites are also in progress on the Diyund and Killing rivers in the Kopilli Basin and the Tirap, Nampukh and Namchik tributaries in the Dihing basin.

II. *Tripura.*—Preliminary studies from the topo sheets for the location of dam sites on the Gumti and Khowai rivers have been completed and field surveys are being taken up.

III. *Bhopal.*—(a) *Burna Project.*—Detailed investigations for an irrigation project on the Barna river are in progress and the project report is expected to be completed by the end of the current working season.

(b) *Kolar Project* : Detailed investigations for an irrigation-*cum*-power project on the Kolar river are also in progress.

IV. *Vindhya Pradesh.*—At the request of the State Government the C.W. & P.C. have taken up investigation of 9 minor irrigation schemes on the Tou Ken, Son, Satra, Nagda Nala, Mirahasan rivers.

Programme ahead.—With a view to assisting the States in getting some river valley projects investigated for inclusion in their development programme for the 2nd and 3rd Five Year Plans, investigations on the following projects will be taken up shortly at the request of the concerned States :—

Assam.—(a) Preliminary investigations on the Subansiri river.
(b) Detailed investigations for the Kopilli Project.
Manipur.—(a) Power Project on the Thoubal river.
(b) Power-*cum*-drainage schemes for Logtak lake.
Madhya Pradesh.—(a) Hasdeo river Project.
(b) Panch Kauhan Canal Project.
(c) Upper Wainganga Project.
(d) Bagh river Project.
Madhya Bharat.—Betwa Valley Scheme.
Travancore-Cochin.—Alladi river scheme.

Flood Wing

The Flood Wing, which was set up in the Central Water and Power Commission in October, 1954, continued to give technical assistance to the States where necessary, and scrutinize all flood control schemes estimated to cost Rs. 10 lakhs and above.

Surveys and Investigations.—Since the formation of the Flood Wing, the work on surveys and investigations by Central Departments has made good headway. Aerial photography of 28,351 sq. miles and tertiary levelling of an area of 5,204 sq. miles were completed in the States of Uttar Pradesh, Bihar, West Bengal and Assam by the end of the 1954-55 working season. Further survey work has been taken up during the 1955-56 working season in the States of Jammu & Kashmir, Pepsu, Punjab, Orissa and Andhra ; till the end of January, 1956, photography of 11,709 sq. miles and tertiary levelling of an area of 2,709 sq. miles were completed in all these States.

Field Investigations.—Four Investigation Circles under the Commission continue to function—one each for the Brahamputra Basin (Assam), the Ganga Basin, the Central India and Deccan Rivers and the North-Western rivers. In Assam, topographical surveys in a stretch of 450 miles of the Brahmaputra basin and in about 1,800 miles along its tributaries, are in progress. 45 per cent of the work was completed till the end of January, 1956. In addition, hydrological observations on the Brahmaputra and its 54 tributaries have been taken up. Hydrological observations on six sites and silt observations on four sites on the Godavari in Central India have also been started.

These Investigation Circles also collate and anlyse the data collected by the States and supplement them wherever necessary for preparing bain-wise reports aimed at integrated flood control planning and unified development of water potential in each basin.

Planning and Designs.—Estimates for 62 flood control schemes, *e.g.*, embankments, town protection, detention reservoirs and raising the level of marooned villages (each scheme estimated to cost Rs. 10 lakhs and above), amounting to Rs. 29.35 crores, received from the various States were technically examined.

Designs, drawings and specifications for the Hanumannagar Barrage of Kosi Project (Bihar) were finalised after a study of the various alternatives.

An "Embankment Manual", intended to serve as a guide to the States engaged on the design and construction of embankments, was prepared.

The programme for 1956-57 will be :—

(*a*) Preparation of comprehensive schemes for the river bains will be undertaken :

(*b*) The projects to be undertaken under the Second Five Year Plan will be scrutinized technically :

(*c*) Technical manuals on detention reservoirs, spurs and other flood control works will be prepared.

Hydrology and Statistics.—Studies in respect of the Rapti basin (Utter Pradesh) and the Burhi Gandak basin (North Bihar) were made and the results embodied in two separate reports. The study of the flood hydrology of the Yamuna river was undeertaken for the benefit of Uttar Pradesh, Punjab and Delhi States. Detailed hydrological studies of the Bagmati and Kamala rivers (Bihar) are in hand.

Hydrological aspects of more than 50 river valley projects for irrigation and power proposed by the States were examined.

Silt and Construction Materials.—The Materials section assisted the Kosi Administration in carrying out soil surveys and exploration of quarries and in establishing field laboratories. Research was carried out to evolve alternative materials in place of stone which could not often be obtained within economic distance from the work-sites and for evolving suitable bank protection materials. Soil samples from various earth dams and flood control projects, proposed and under construction, were tested.

The Silt Section assisted in establishing 49 silt

Observation sites on the Brahmaputra and its tributaries and on the Godavari, the Krishna, etc. The data received from the Silt Observation sites were checked for the preparation of reports.

Power Wing

Hydro-electric Directorate

A systematic and detailed assessment of the water power resources of the country was initiated in the Power Wing of the Central Water and Power Commission early in 1953. The hydro-electric survey of (a) the West Flowing Rivers of the Western Ghats (b) the East Flowing Rivers of Southern India, and (c) the Rivers of Central India, has been completed. The work of assessing the power potential of the Ganga and the Indus along with their tributaries is now is hand.

On behalf of the Government of Assam, the details of plant and equipment for the Umtru Hydro-electric Project were settled. Assistance was rendered in connection with the finalisation of the specification for turbines, generators, etc., for the Koyna and Rihand Projects. Detailed examination of the tenders for the generating plant and equipment for the Chambal and Bhakra Projects was made and the Commission's recommendations thereon were sent to the authorities concerned.

The experimental model of Michell-Banki turbine was completed. Tests and experiments on the model are in progress on the Rajghat Power Station of the Delhi State Electricity Board. The small standardized hydro-unit, when developed, will be useful for the electrification of remote places in the hilly areas of the country.

Thermal Directorate

The first phase of the work of the Central Power Station, Kandla, which is intended to supply power to the Kandla port area and the neighbouring villages, has been completed. Orders for the plant and machinery for this power station have been placed and the layout designs finalised.

Assistance was rendered to the State of Rajasthan in respect of investigation, drawing up of specifications, analysis of tenders and orders to be placed for the plant and machinery for six steam power stations in that State. Assistance was also rendered to the State of Bhopal in respect of layout designs and specifications for the third stage extensions to the Bhopal Thermal Power Stations.

System Planning Directorate

The States of Rajasthan, Kutch, Ajmer, Bhopal, Manipur and Himachal Pradesh were assisted in the matter of scrutiny of electricity schemes, preparation of scheme reports and specifications of plant required, analysis of tenders and procurement of electrical equipment.

The Commission conducted a detailed route survey for the construction of 33 KV transmission line from Kandla to various important load centres in Kutch.

A scheme for the erection of a thermal station at Nanded and the extensions of 33 KV lines for electrification of some of the localities in Hyderabad, was examined.

Transmission Directorate

The technical aspects of Transmission Schemes of a number of power projects proposed to be included in the Second Five Year Plan were examined. Amongst the more important schemes examined are the Tungabhadra-Nellore Thermal Project, the Nandikonda and Sileru Hydro-electric Schemes in Andhra State ; the Korba Thermal and the Tawa Hydro-electric Schemes in Madhya Pradesh ; the Kundah Hydro-Electric Scheme in Madras State ; the Yamuna Hydel Scheme in Uttar Pradesh ; and the North Gujerat, the South Gujerat, the Jog-Karnatak and the Koyna-Sholapur Electric Grid Schemes in Bombay State.

Technical assistance was also given to State Governments and project authorities in respect of certain other projects, including the Rihand Transmission System in Uttar Pradesh, the scheme for the supply of power from Hirakud to the Rourkela Steel Factory and Ferro-manganese mines near Joda and Rairangpur, and the transmission and distribution systems and estimates of the D.V.C.

Technical assistance was given, as hitherto, to the Indian Standards Institution in connection with the preparation of various Indian and International Standard Specifications for electrical equipment and apparatus and various codes of practice relating to transmission and distribution lines and equipment.

A scheme for 'Hot-Line' maintenance crew training in India, with the assistance of T.C.M., involving a total Dollar expenditure of 240,000, and Rupee expenditure of 7.86 lakhs was drawn up. The scheme provides for the establishment of two training centres and has been approved by Government.

Detailed examination was continued, in consultation with the Forest Research Institute of the requirements of the State Electricity Departments for wood poles, the existing facilities for their treatment and the progress to be made up, and their availability in the various States. The object of the examination is to ensure maximum availability and use of treated wood poles for overhead power lines.

Rural Electrification Directorate

Rural and small town electrification scheme of the States to be included in the Second Five Year Plan were examined under the programme of 'Expansion of power facilities for increasing employment opportunities." These schemes are expected to result in the electrification of an additional 10,000 villages and some 500 small towns at an estimated cost of Rs. 90 crores.

Work in connection with the development of suitable and economical designs consistent with reliability and safety, and codes of practices for the execution of rural electrification schemes, has been initiated. In this connection, the services of an expert in the field of rural electrification have been obtained under the T.C.M. Programme.

The Commission is collecting relevant, technical data in regard to rural electrification in the country. It is also engaged in a study of the financial working of the electricity supply undertakings in the States with a view to correlating the result of study with the question of the grant of subsidy for rural electrification.

Load Survey and Developments Directorate

The Commission is undertaking a systematic power load survey of different regions of the country with a view to (i) assessing the load requirements of each State in connection with their development schemes, (ii) drawing up a properly co-ordinated programme of power development and utilisation in order to ensure the availability of power at economical rates in any locality, regardless of State boundaries, and (iii) collecting data for a study of the existing power supply position and the anticipated trend during the next 15 years, commencing with the Second Five Year Plan. In this connection, the Commission has drawn up a phased programme spread over a period of 4 years, and has organised four load survey groups to cater to the requirements of the various regions in the country. The work will be done in close collaboration with the Electricity Departments of the States concerned.

For the planning of schemes to be undertaken in the immediate future, it was decided, as an emergent measure, to carry out initially a preliminary load survey of all the States with the help of such material as had been collected by the States.

So far, the Commission has carried out the preliminary load survey of the States mentioned below :—

1. Vindhya Pradesh
2. Ajmer
3. Bhopal
4. Pepsu
5. Delhi
6. Punjab
7. Manipur
8. Tripura
9. Assam
10. Bihar
11. Rajasthan

The load survey reports for the States of Vindhya Pradesh, Ajmer, Bhopal have been completed. The reports for the other States are under compilation.

Technical Co-ordination Examination and Research Directorate

The Commission continued to keep itself currently informed of the progress of major power development projects in the country and of the power availability and power demand position in the States. A detailed note on power development projects in the States was prepared. The third edition of the publication entitled : "Planning for Power Development in India" was brought out. Charts showing the progress of power projects such as the D.V.C., Bhakra-Nangal, Hirakud, Chambal, Tungabhadra, Rihand, Koyna, etc., were prepared. The Commission continued to examine the reports on power projects proposed for inclusion in the Second Five Year Plan, and offer its comments to the Advisory Committee on Irrigation and Power Projects set up by the Planning Commission and to the Central Electricity Authority.

The Commission also prepared, in close collaboration with the Planning Commission, estimates of manpower, raw materials and foreign exchange requirements, etc., in connection with the power projects under the Second Five Year Plan.

The Commission rendered technical assistance to the Ministries of Production, Commerce & Industry, Iron & Steel, in planning and finalising project reports on major industrial schemes like the Steel Plants at Bhilai, Rourkela and Durgapur, Lignite Plant at Neyvelli, Heavy electrical manufacturing plant, Fertilizer-*cum*-Heavy Water Factory, etc.

The Commission submitted a note to the Tariff Commission regarding the question of continuing the protection to the Distribution Transformer Industry beyond the 31st December, 1955.

Plant Construction and Procurement Directorate

Installation of 5 thermal power plants, and one boiler plant was completed. Dismantling of two thermal power plants and their reinstallation is nearing completion. Dismantling of 10 thermal power plants has been in progress.

The Commission continued to function as the sponsoring and recommending authority for the allocation of steel, cement, and coal, etc., for distribution to electric projects and utilities. It also scrutinised and recommended 1,294 applications for the import of electrical plant and equipment, valued at about Rs. 22,67,798.

Commercial Directorate

The Commission continued to function as an Electrical Inspectorial organization for the States of Bhopal, Himachal Pradesh, Kutch, Tripura, Vindhya Pradesh, Manipur and Andaman & Nicobar Islands and *ex*-French establishments.

The work of re-drafting the Indian Electricity Rules, on the basis of the decisions taken at the ninth meeting of the Central Electricity Board held in October, 1955, is in hand.

During the year under review, there were as many as 735 public electric utilities operating in the country, of which 419 were owned by the public sector and 316 by the private sector. The total production of electricity during the year 1955-56 is estimated at 8,705 million kwh. of which about 48 per cent will be generated by the public sector and 52 per cent. by the private sector. Approximately 826 small towns and villages were electrified during the year ending 31st December, 1954. In addition some 1,839 small towns and villages are expected to be electrified by the end of 1955-56, increasing the total number of towns and villages which enjoy the benefits of electricity to 6,860 at the end of the First Five Year Plan period. The *per capita* consumption of electricity during the last five years increased from 10kWh in 1949-50 to about 19 kWh in 1955-56.

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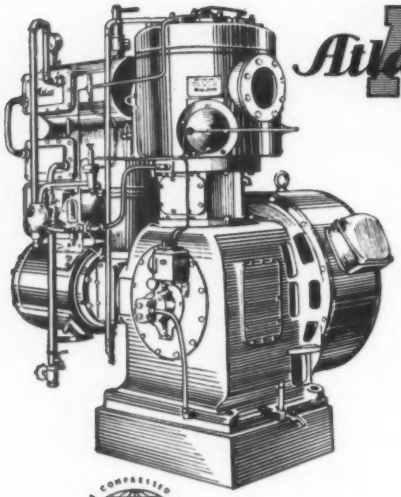

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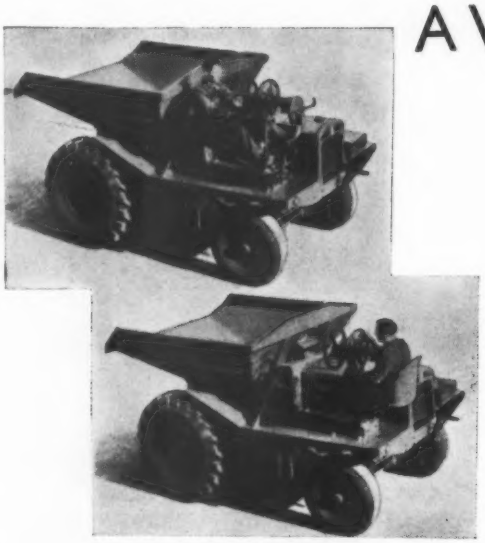

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Modern Steam Turbines

The steam turbine, developed in the early years of the present century as a prime mover for obtaining economical supplies of electrical power, still maintains its unrivalled position for driving small or large electrical generators.

In this article prepared by the English Electric Company, attempt is made to review progressive stages of development during the past few decades and to consider briefly some of the factors, technological and economic, governing this progress.

The most outstanding characteristics of modern generating units are large output, high steam conditions, high efficiencies and a high degree of reliability. These characteristics are not peculiar to the present time, however, since a number of machines built twenty or thirty years ago embodied one or other of them to a degree relative to the date of manufacture.

Whereas the pressures for which those early machines were designed were high, even judged by modern standards, the temperature never exceeded 900°F. This was due to the fact that certain metallurgical problems still remained to be solved and alloy steels having the necessary creep strength at more elevated temperatures were not available.

Larger and more efficient machines, because of ever-increasing modern demands, have necessitated further developments in design with a view to utilising every advantage of the steam cycle. Whilst the desired increased efficiency a few decades ago was obtained from improving the feed heating circuit, modern conditions have resulted in the employment of higher initial conditions with or without reheat to secure the utmost advantage.

Allied with technological problems is the question of economics. This is a fundamental consideration and merits particular attention. Availability and cost of fuel are becoming of paramount importance. There is also the possibility of alternative sources of power. These inter-related factors influence the trend of modern design. Thus, if electricity can be produced more cheaply by some change in design, whether it be an increase in size, in the number of cylinders, or by using higher steam conditions, then that change is justified, provided it is not made at the expense of general performance and availability.

The solution to the problem, it will be appreciated, is not a simple one and involves consideration not only of the factor of thermal efficiency and its effects on the cost of fuel consumed, but also the related factors of greater capital expenditure and the need for more highly skilled and more highly paid personnel. There is, moreover, the possibility that maintenance costs may be higher for the higher steam conditions.

Fundamental Principles

To appreciate fully the reasons for modern trends in the design of steam turbines, it is necessary to understand certain fundamental principles. At the outset it may be as well to emphasise that the changes that have had the greatest effect on design have been the continuous increases in size of unit and in steam conditions.

The main factor governing the use of higher steam conditions is that, which the boiler supplies both latent and sensible heat to the steam, the turbine can use only the sensible heat. The greatest loss in the cycle is the latent heat, which passes to the condenser circulating water. By increasing the temperature and the pressure, the proportion of sensible heat in the total heat of the steam is increased, and with it also the efficiency of the turbine thermal cycle.

Basically the steam turbine is a machine for converting the potential energy of the steam into work, and to do this either the impluse or the reaction principle is used. Whilst it has been reliably demonstrated that the reaction principle is inherently slightly more efficient than the impulse when applied to steam turbine blading, it has also been shown that under certain conditions those advantages are outweighed by other factors, chief among these being the problem of leakage of steam past rotating nozzles or blades where there is a difference of pressure.

It would be unwise, therefore, to generalise and state that either impulse or reaction is invariably more efficient, as it would depend largely on the conditions in individual machines. By and large it will be found that manufacturers favour the use of impulse blading at the high-pressure end where the steam areas are small, and leakage consequently of greater importance, and reaction blading at the low-pressure end where the flow areas are large and leakage losses relatively smaller.

One factor tending to limit progress in employing higher initial steam conditions is a general deterioration in the properties of steel at high temperatures. These adverse effects become noticeable above 800°F. and there is a tendency nowadays to use alloy steels containing possibly chromium, nickel, vanadium, tungsten etc., in addition to molybdenum. As the whole problem of high-temperature materials is one of considerable difficulty, it must suffice here to state that a vast amount of research is being undertaken with some success.

Rotors for advanced steam conditions are now manufactured from solid billets of steel, the required discs being machined out of the solid. Up to 750°—800°F. carbon-steel rotors have proved acceptable, but above this temperature the material becomes subject to deformation due to creep. Small additions of molybdenum are employed to resist this tendency. Beyond 900°F. other alloying additions as stated above are used to stabilise the steel.

Cast iron casings have now been replaced with alloy steels similar to those used for rotors. In the high temptrature ranges above 1000°F. ferritic and austenitic materials are being used, although the latter has

given some trouble due to undesirable properties affecting welded connections. With increasing experience even this difficulty is being overcome.

Standardisation

Having in mind the foregoing considerations, and the rapid expansion of demand for various sizes of machines, it will readily be seen that the time had to come when the rival claims of operating efficiency of individual machines had to be balanced against the need for a desired improvement in production efficiency. This provided the necessary justification for the introduction of a limited number of designs ; in other words, standardisation.

Table I gives the standards agreed upon by the International Electro-Technical Commission (IEC) for 3000 r.p.m., 50-cycle turbo-alternator sets, and Table II gives the American Preferred Standards for large 3600 r.p.m., 60-cycle turbo-alternator sets. Table I has been extended by the British Central Electricity authority to include a 200 MW reheat unit with stop valve conditions of 2350 lb. per sq.in., 1050°F., and a reheat temperature of 1000°F.

TABLE I

Agreed International Standards for 3000 r.p.m., 50-Cycle Turbo-Alternator Sets

Straight Cycle

Continuous Maximum Rating MW	*Steam Pressure at Turbine Stop Valve lb. per sq.in. gauge*	*Steam Temperature at Turbine Stop Valve °F*
100	1500	1050
	or 1250	970
60	900	900/930
and 50	or 1250	970
30	900	900/930
and 25	or 600	850

Reheat Cycle

Continuous Maximum Rating MW	*Stop Valve Pressure lb. per sq.in guage*	*Stop Valve Temperature °F*	*Reheat Temperature °F*
120 / 80	1500	1000	1000
	alternatively		
60	1250	985	960

Exhaust pressures : 1.01 in. Hg. abs. or 1.88 in. Hg. abs. at M.E.R

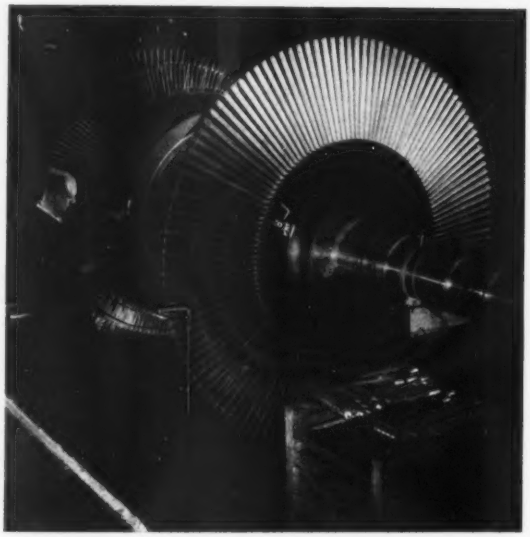
TABLE II

American Preferred Standards for Large 3600 r.p.m., 60 Cycle Turbo-Alternator Sets

Turbine rating MW	33	44	44	66	66	100	100	150
Stop valve pressure, lb. per sq.in. gauge	850	850	1250	850	1250	1450	1450	1800
Stop valve temp. °F.	900	900	950	900	950	1000	1000	1000
Reheat temp. °F.	—	—	—	—	—	—	1000	1000
Exhaust pressure, in. Hg. abs.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

Reheat

Reheat is employed to overcome the disadvantages of excessive wetness in the steam at the exhaust end of the turbine due to the use of very high initial pressures, especially with 100 MW and larger units. The steam, after expansion through part of the turbine, is reheated to approximately the same temperature as the initial live steam. Thus, for example, it is possible to keep within 12% moisture at the low-pressure end of a turbine designed for 1500 lb. per sq.in. by using an initial steam temperature of only 970°F. (instead of the preferred standard 1050°F.) and reheating it after expansion back to, say, 950°F.



Fitting shrouding to the low-pressure rotor for a 60,000 kW steam turbine for the British Central Electricity Authority in the Rugby Works of The English Electric Company.

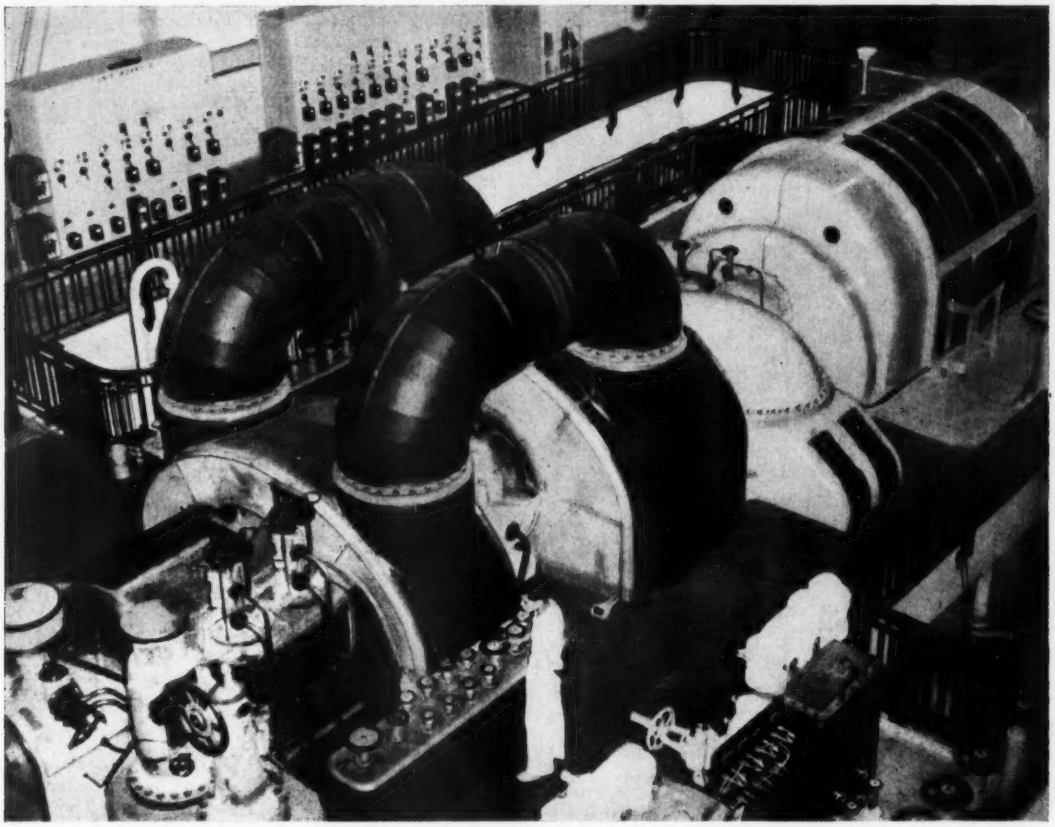
With reheating there will be additional steam pipework as the steam has to be conveyed back to the boiler and from the boiler to the turbine again. Safeguards in the form of control gear are necessary to prevent the considerable volume of steam stored in the pipework and in the reheater itself from over-speeding the turbine on sudden loss of load.

Supervisory Control

The modern requirements for fuel economy and larger units have led, as previously described, to the use of progressively higher steam pressures and temperatures. It is characteristic of turbine plant that the higher the operating conditions, the greater will be the mass of the cylinder relative to the rotor. Strict control of the differential expansion that results from these variations in mass must be maintained particularly during starting up and shutting down and also during those periods of large changes in load.

In the modern power station operating at 900 lb. per sq.in. gauge and above, it is now desirable to install indicating and recording instruments to provide the operating staff with increased and more reliable control of variations in internal clearances, which could become dangerous.

The typical equipment consists of axial expansion indicators and eccentricity indicators. Differential expansions can be kept under control by providing



One of two 'English Electric' 15,000 kW, 3000 r.p.m. turbo-alternator sets in the Basin Bridge 'B' Power Station of the Government of Madras Electricity Department, India.

steam heating of the casing or by thrust block adjusting gear.

Damage can be caused when starting up turbines due to the rotor being out-of-truth through unequal heating. Eccentricity indicators and recorders provided at suitable positions on the shaft, show the amount of out-of-truth existing, and enable the appropriate remedial action to be taken before any harm is done.

Hydrogen-Cooled Alternators

The most striking advance in alternator design in recent years has undoubtedly been the introduction and development of hydrogen cooling. It is of interest to note that the idea of using hydrogen as a coolant is not entirely new, a patent having been taken out in America as early as 1923.

The first hydrogen-cooled alternator to go into commercial operation was built in 1937. Since that date rapid developments have taken place notably in the U.S.A., where a recently-quoted figure states that approximately 25,000,000 KW of hydrogen-colled plant has been installed.

Although the principles governing the use of hydrogen for the cooling of rotating electrical machines are now fairly well-known, it may be of interest briefly to summerise the main advantages to be derived from the use of this gas. These are :—

(1) Improved efficiency owing to the reduction of the windage and ventilation losses on account of the very low density of hydrogen, which is about one-fourteenth that of air.

(2) Greater output per unit weight of active material (the iron and copper in the stator and rotor) and reduced temperature gradients because of the superior thermal conductivity of hydrogen compared with air.

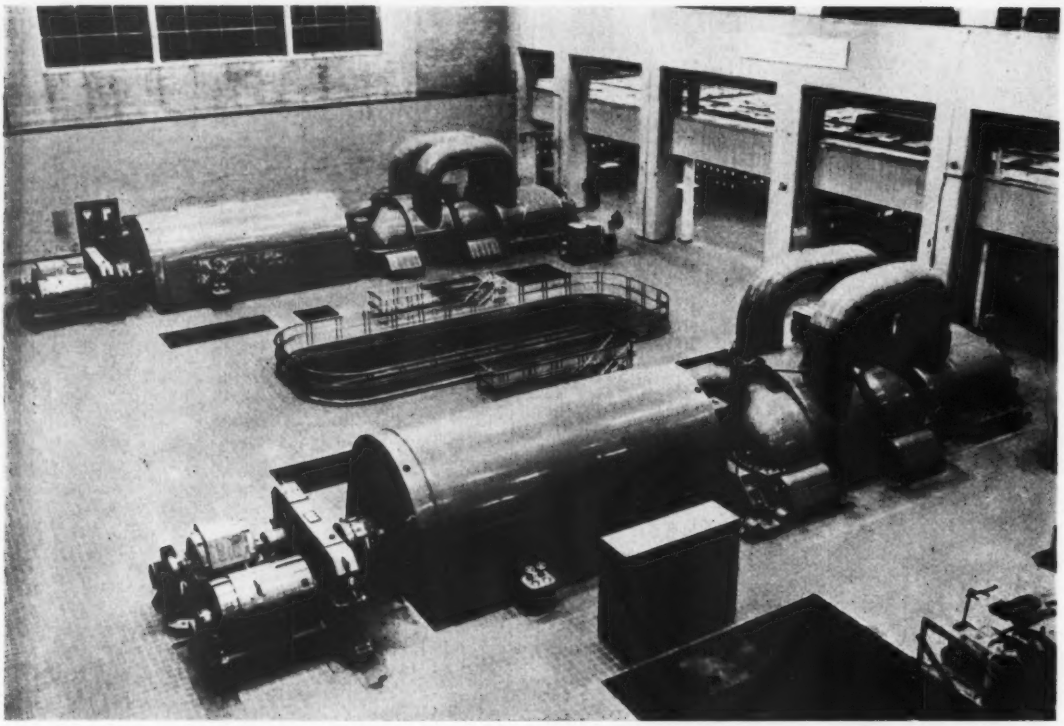
(3) The virtual elimination of the deterioration of the insulation due to corona.

(4) The absence of the fire risk because hydrogen will not support combustion.

(5) A reduction in windage noise due to the low density of the gas.

(6) Greater cleanliness due to exclusion of dirt by the complete sealing of the machine.

Operating experience with the hydrogen-cooled alternator has confirmed that the output for a given temperature rise can be increased with an increase in the hydrogen pressure inside the machine. For a machine designed to operate with a normal gas pressure of $\frac{1}{2}$ lb. per sq.in. gauge, it has been found that the increase in output follows a straight line with



Two of four 'English Electric' 66,000 kW, 3600 r.p.m. turbo-alternator sets in the J. Clark Keith Generating Station, Windsor, Ontario, Canada.

increase in pressure up to 15% above atmospheric pressure. Beyond this the output of the machine increases at a lower rate giving a total of about 25% above that at ½ lb. pressure when operating at 30 lb. per sq.in.

The most recent practice makes use of the principle of direct cooling of the alternator windings by passing the coolant in direct contact with the conductors.

Future Development

Turbine designers, still concerned to obtain higher efficiencies than those associated with 1500 lb. per sq.in. gauge, 1050°F. steam plant and always up against the difficulty of finding suitable materials, have employed reheating. The benefits accruing from reheat (4% to 5% on heat rate) on large units where fuel costs and load factors are high may very decidedly outweigh the complications. The British Central Electricity Authority has now placed the order for the first 200 MW reheat sets to be manufactured in Great Britain. Multi-reheat even now becomes an interesting possibility with the promise of further gains. With the growing experience in the application of the reheat principle, double reheat has been considered for pressures of the order of 2400 lb. per sq.in. gauge and above, resulting in a further gain of about 1½% to 2%.

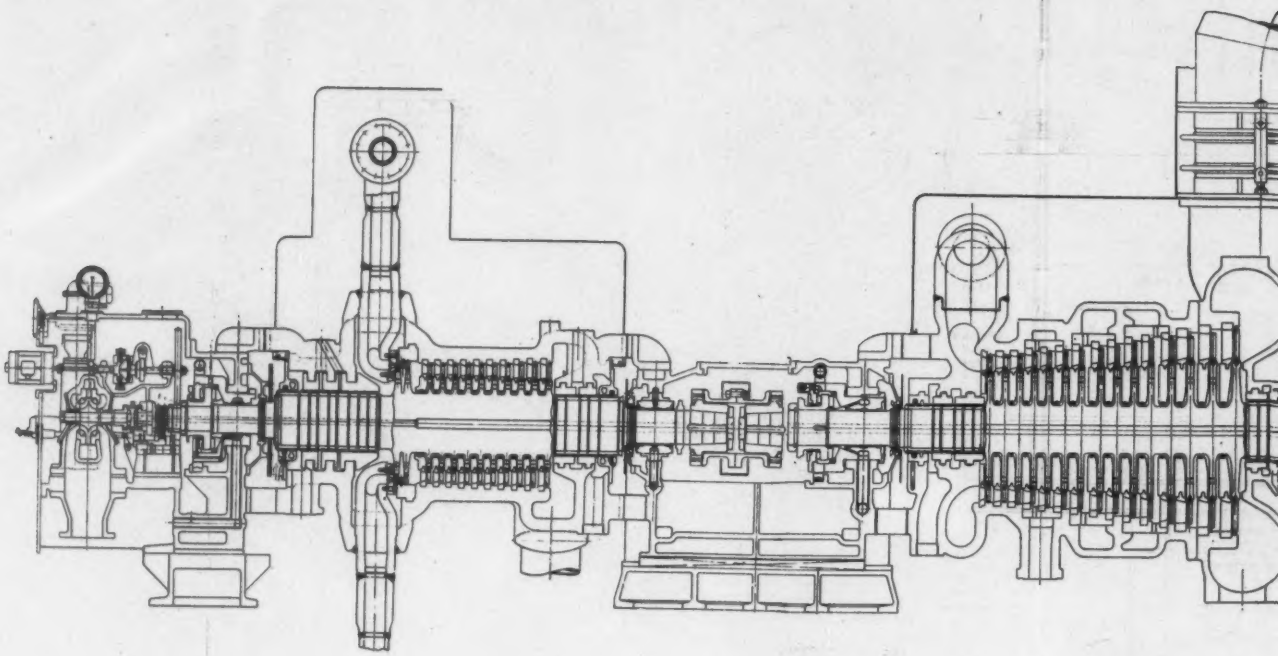
Although it has not been possible to deal with the feed circuit in this article, it may be of interest to refer to recent trends that have contributed to the improvements in operation and performance. High level de-aeration at above-atmospheric pressures has been gaining acceptance in Great Britain. Unit evaporators have in many instances been supplanted by central evaporators, and de-mineralisation with certain kinds of feed water has proved itself to be both reliable and competitive in first cost.

Nuclear Power Stations

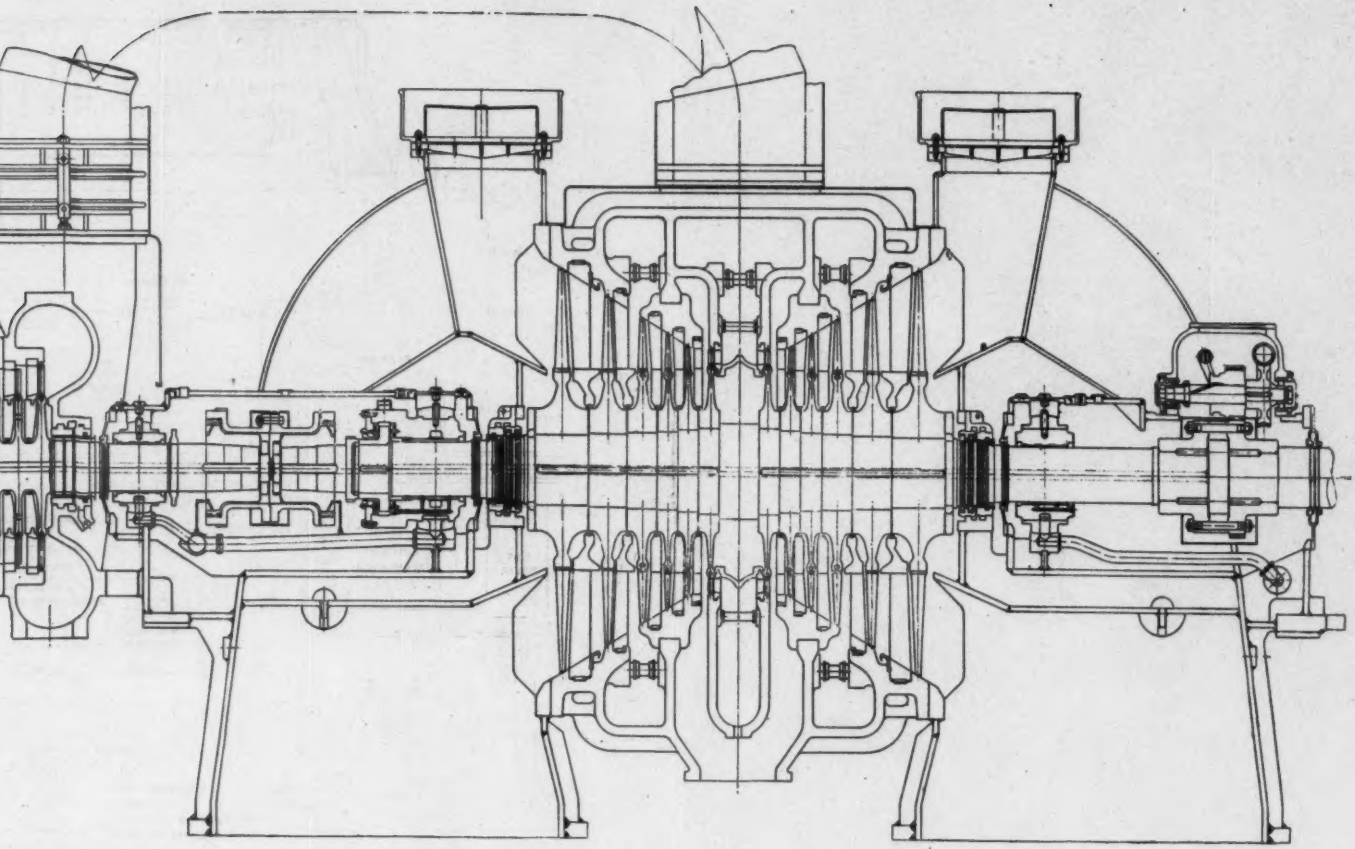
No survey of steam turbines would be complete without some reference to the impact of nuclear power stations. According to information recently made public by the Central Electricity Authority, it is anticipated that by 1975 nuclear reactor power stations in Britain will have an aggregate installed capacity of between 10,000,000 and 15,000,000 KW and about half the national consumption of electricity will be derived from nuclear energy. However, it is still true to say that the steam turbine remains an essential link in the chain.

Conclusion

The present article has been based on information made available by The English Electric Co. Ltd. Illustrations show typical turbines designed by the Company, which has developed and built a complete range of types and sizes, and for fifty years has pioneered the introduction of higher steam pressure and temperatures. The Company's unique experience in pioneering developments has been put at the disposal of the British Central Electricity Authority, which has entrusted The English Electric Company with the order for three 200 MW sets for the High Marnham Generating Station. These large machines—the largest ever to be built in Great Britain—will embody many improvements among which may be mentioned reheating and also direct-cooling of the alternator windings.



Sectional elevation of an 'English Electric' 100,000 kW



200,000 kW steam turbine to agreed International Standards.

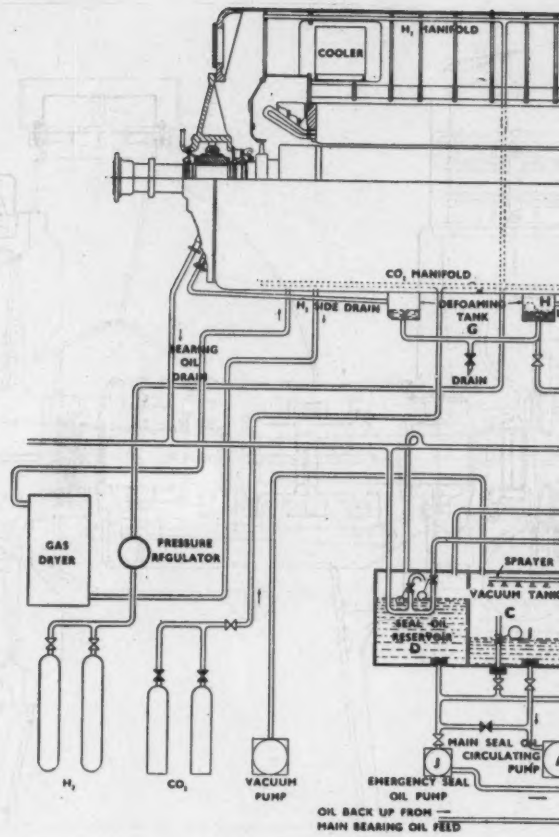
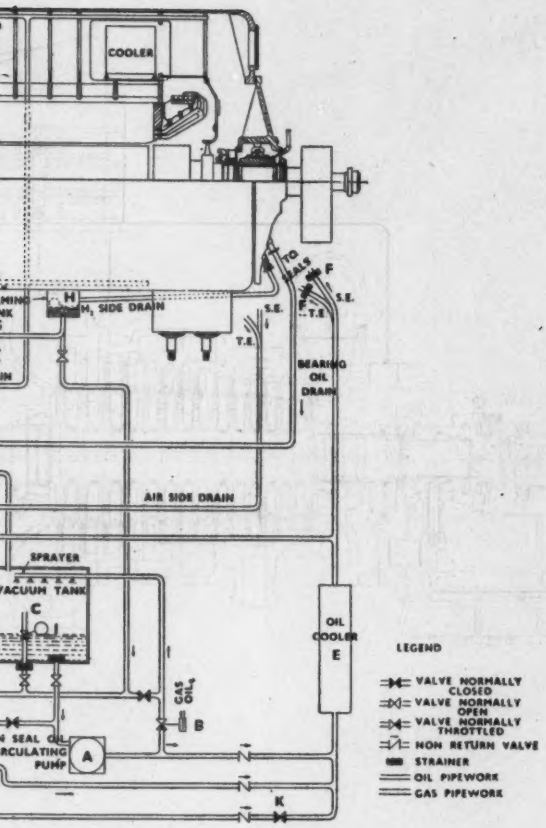


Diagram showing the hydrogen and seal oil system



oil system for a hydrogen-cooled turboalternator.

Financial Problems facing the Private Electricity Undertaking

By

K. G. MILNE
Chairman, Ahmedabad Electricity Company Ltd

The following is an extract from the speech by Mr. K G. Milne, Chairman of the Ahmedabad Electricity Co. in its annual meeting held recently. It is being published to give an idea of the problems of finance and the relationship between the private electricity undertakings with theState arising out of recent legislation and policies, and their impact on the minds of investors.

During these years of rapid investment and expansion with high-cost plant and attendant high annual capital charges, and with rising expenses levels generally, even the very modest return permitted under the Electricity (Supply) Act has not been achieved for several years past. For the year under review we are short of it by the calamitous figure of Rs. 27 lacs. We have been caught by the continued necessity to expand even within the by-no-means adequate level of return prescribed under the Electricity (Supply) Act, what-time our charges for Electricity have been conditioned by politics and by the contradictions inherent in diverse provisions of the Electricity (Supply) Act versus the Indian Income Tax Act, as repeatedly stressed from this Chair at former Annual General Meetings. Hence it has only been possible to keep up our moderate dividend level at all by drawing subsistence from the tax relief resulting out of accelerated Depreciation Allowances given under the provisions of the Income Tax Act, but which properly should have been made additionally available for us to place in Reserve to meet the corresponding future tax liability which must arise when the Allowances decelerate in their turn.

The proposal of the Company in April 1954 to put its house in order by a 15% increase of its rates, was overtaken by the imposition by Government of a Rating Committee whose Reports is common knowledge to you all. This was followed by the freezing of the Company's old rates where they stood, and until circumstances changed. In the meantime the Company referred for arbitration by the Central Electricity Authority the long-standing dispute with the State Government over the admissibility of interest on Loan and Debenture Capital as an item of operating expenditure for purposes of determining the Clear Profit. The Award of the Central Electricity Authority in the Company's favour was not announced until April 1955, but when it came it proved a fundamental change in the circumstances as viewed by the Rating Committee, and there followed at once a resumption of negotiations with the State Authorities for an upward revision of rates. Unfortunately even then these negotiations were prolonged, and it was only at the beginning of the current year that an $8\frac{3}{4}\%$ surcharge on supplies to Industrial and Commercial H.T. Consumers could be effected. No benefits to the Company's finances could therefore accrue during the year ended 30th September 1955. The delays and curtailments inherent in these developments, which have been entirely beyond the Company's control, have culminated in the diminution in the Company's disposable surplus to the point we have reached in the proposal for a lower dividend.

It might be asked whether we could not have availed of the Dividends Equalisation Reserve to a greater extent than Rs. 6 lacs to maintain the Dividend level, in the hope that earnings hereafter would equal the return permitted under the Electricity (Supply) Act. I may say that your Directors have given most careful consideration to this point, but a number of factors have influenced them to come down on the side of austerity. Our liability for payment of Tax at present deferred is gathering momentum. The final verdict on the liability of the Company for Additional Income Tax in respect of past years, and to which I will refer later, is still unresolved. The margin of profit allowed by the law makes it likely that, even in the best years, subsequent replenishment of free Reserves will be possible only in meagre amount, if at all. In the circumstances it has been thought best to conserve our resources, already drawn down to a level incommensurate with the size and position of the Company, so that we may be better able to meet contingencies which might arise. I feel confident that in the light of the circumstances you will be in agreement with this policy.

The Electricity (Supply) Amendment Bill introduced in the Lok Sabha in September 1955 still awaits reference to a Joint Select Committee of both the Houses of Parliament. If this materialises during the current Budget Session of Parliament, the Bill might find its place in the Statute Book before the close of the Company's current financial year. From the financial point of view the principal changes sought to be made to the Electricity (Supply) Act are three. First, the proposal to link the Standard Rate to the Bank Rate with a differential of 2% (instead of the present fixed overall level of 5%). Second, to provide for the Electricity Supply Industry to "avail of the benefits of the Development Rebate permitted under the Finance Act, 1955". Third, to disallow Debenture and Loan Interest as an expense in the computation of permissible Clear Profit, on the ground that Debentures and Loans find their places in the Capital Base upon which the Standard Rate of return is already allowed.

Much has already been said about the need for greater incentive to sustain and promote investment in the Electricity Supply Industry, and it is most

unfortunate therefore that the proposal regarding the Standard Rate as outlined in the Bill will not positively ease the Industry's difficulty in raising finance for expansion. The situation calls for a differential over the Bank Rate of 2½% at least. Even with that, there will be no scope for providing that measure of internal finance which the extensive Capital development programmed for the Industry in the Country's Second Five-Year Plan could absorb. With the disappointment prevalent regarding "Electrics" amongst the investing public, approaches to other agencies, e.g. Banks and Investment Corporations, for the necessary finance will become imperative more often than not. What the fate of such approaches will be, and no what terms of interest and security such agencies might lend, if at all, gives much food for thought ; especially when viewed in contrast with the very low rate of statutory return delimited for equity capital itself in this Industry. In this connection I should like to say how grateful we are as a Company to the Bank of India Limited for the confidence they have always shown in us, and for the great volume of assistance they have rendered to us on most fair terms over the last few years.

While the proposed revision of the Standard Rate does not enthuse the Industry, the provision in the Bill with regard to a Development Reserve is extremely unwelcome as it stands. Any compulsory appropriation to Development Reserve ranking as a prior charge in the calculation of the Clear Profit would create a perilous position indeed, for who could be sure of being able to earn enough Clear Profit in every year both to meet this prior charge and the full Reasonable Return. An appropriation based, not on revenue surpluses of any year, but on 25% of capital expenditure during that year, must give rise to fluctuations with which the tariff structures of a tightly regulated and capital intensive Industry, such as ours, could never adequately cope. Moreover, the creation as proposed of the Development Reserve visualises no benefit to shareholders, since the Reserve would have to be deducted from the Capital Base and ultimately passed on to any purchasing Authority. The authorities have been specially apprised of the dangers, and the suggestion has been made that at least appropriations to any statutory Development Reserve should be made optional within a limit, so that the virulent threat of such a Reserve encroaching upon the Reasonable Return would be removed.

The proposal to negative the allowance of Debenture and Loan Interest as a charge before arriving at permissible profit, will remove an advantage which played its part in helping us to maintain a level of return sufficient to attract new Capital during all the years of heavy capital expenditure since 1948—the year the controlling Act was passed. During these years we raised and invested in Electric service Rs. 5¼ crores of equity capital and Rs. 1½ crores of debentures. Now in fact your Company stands to lose more from disallowance of interest figures than it stands to gain from the proposed upward revision of the Standard Rate of return. Thus when we asked for bread in the shape of greater incentives to attract more capital, we are in fact likely to be offered a stone, as the proposals before Parliament are framed at present.

The draft outline of the Second Five-Year Plan refers to the need for a re-statement of the Industrial Policy Resolution formulated by Government in April, 1948, so as to indicate "fresh fields to be reserved for public enterprise, the fields in which public enterprise is to take on larger responsibility and the fields in which private enterprise is to function subject to overall regulation and control." Until this re-statement has taken place it is difficult to foresee that the future of the Electricity Supply Industry will be, but considering that the Industry is subject to rigorous financial control by the Electricity (Supply) Act there is no reason why the place at present occupied by the private enterprise of the Industry in the country's power development should not be maintained. There have recently been discordant notes about the respective roles of the Public and Private Sectors, but the Planning Commission has stated that the "two sectors have to function in unison and are to be viewed as part of a single mechanism. The Plan as a whole can go through only on the basis of a simultaneous and balanced development in both sectors". I am entirely in agreement with this view.

To those who repeatedly advocate nationalisation of Electricity Undertakings the unfortunate position of consumers in Madras State should stand as a warning. For several years, this State has been repeatedly hit by droughts which seriously curtailed Hydro-Electric Supplies, and yet after all these years, the State Authorities, which control 98% of the Generation, have not been able to put their house in order by firming up the Hydro-Electric Plant by suitable additions to the Thermal capacity of their interconnected system. Once again, this year, consumers are being subjected to drastic rationing in their electric supplies.

The first Budget of the Second Five-Year Plan, if nothing much else can be said in its favour, promises to diminish some of the difficulties arising out of the contradictions between the Electricity (Supply) Act and the Income Tax Act in respect of depreciation. The withdrawal of the Initial Depreciation Allowance will assuage the problem of Deferred Taxation to a certain extent ; but only to a certain extent, and that in respect of the future. The abolition of Additional Income-Tax in its past form relative in Dividend will mean that in future this vexed question will no more plague the Electricity Supply Industry. The Sword of Damocles, however, in the shape of the contingent liability for this Additional Income Tax in respect of the past year still hangs over us. Since then, however, the Income Tax Department have gone in appeal to the Supreme Court, with the inevitable delay and uncertainly which this entails. Linked closely with the ultimate ruling by the Supreme Court will be the right to otherwise to "gross up" your dividend from your holdings in this Company ; so you will still have to wait some time yet to have have the long overdue answer to this question. I have told your previously that the Agency Company itself is also involved in this complicated matter and will contest its case at the opportune time.

In November, 1955, the Government of Bombay in the Public Works Department issued a directive to Licensees in the State that "the consent of the State Government is necessary to declare dividends in excess of 3% until all arrears of depreciation are cleared off". The Central Electricity Authority has

Our Delhi Letter

(*From our own Correspondent*)

The 2nd Five Year Year Plan has been launched. The river valley projects figure in the plan no less prominently than in the 1st Five Year Plan. It is not only the amount of allocation but the impact of the river valley works on the lives of the people of India that determines the importance of the river valley programme. Whether in terms of flood protection, insurance against drought or increased yield from land, river valley projects are a vital factor in the lives of the Indian people.

Gap in Resources for 2nd Plan

The question of resources for the implementation of the five year plan becomes all important. There is no doubt that a large gap exists between the available and the required figures of the money for the completion of the entire programme. How is this gap to be filled up ? By additional taxation? That will surely not be very popular. It is being felt by those who have had years of experience in the field of planning and execution, that there is room for a more speedy and efficient achievement if the administrative machinery can be geared up for a more aggressive attack on the problem.

Primary Requisites

The specific suggestions made in this regard are taking the following shape:

a. Continuity of project planning and execution,
b. Inventory of experienced personnel,
c. More realistic estimates ;
d. Schedules of construction determined in the light of resources, suitability and practicability.

It can however be safely asserted that the above requisites will remain wishful thinking unless some of the red and white tape is drastically cut. The conditions are far from satisfactory in the Centre and even worse in the States. At both places the stranglehold is primarily entrenched in the obsolete financial rules which were originally made by a foreign power to support and maintain a static economy. A proof of the statement is that many of the projects now in hand are being cramped and delayed for want of sanctions for petty establishment—typewriters telephones, stationary and the like. It is quite amusing (tragically) that an issue involving lakhs of rupees hangs on a financial pivot which is interested only in criticising the expenditure of few hundred rupees in its old stereotyped manner.

What is indicated is bold and imaginative thought which extends not only to this or the next financial year but the future five, ten or twenty years.

Nandi Konda (Nagarjunsagar) Dam

Coming to specific projects let us look at the proposed Nandi Konda dam in Andhra. This great work will constitute the Bhakra Dam of the South and is expected to cost about Rs. 140 crores.

The construction programme envisages 9 years as the completion period. This time limit can be reduced to 5 years or 6 years provided use is made of modern mechanized methods for some of the operations. Merely the use of hand labour methods and the satisfaction of providing employment to some local masons are not the best economy for the requirement. The early construction of the project will in one season bring so much benefit in employment and production, as will outweigh the small advantage to some labour, if hand methods are used. In such a case it is imperative that a dispassionate view be taken of the relative advantages or disadvantages of the traditional methods and sentiments and emotion kept out of the issues which need to be decided purely on objective or economic considerations.

Needed more Consultation Panels

As has been pointed out in these letters, time is ripe for the constitution of short term consultation panels to battle doubtful issues. Such panels ought to be formed by the experienced engineers within the country selected on consideration of merits alone. The example is already available in the practice of the Indian Standards Institution, which has been working on this basis with great success for the last few years.

Special experts should be hired on appropriate and moderate terms. They should be asked to give their opinion on the doubtful issues within relatively short periods.

It should not be necessary to pull them out of their existing jobs because technical personnel is in very short supply and dislocation on one project is not the best way to help on other project. But consultations with proper arrangement of a due notice and circulation of well prepared agenda bring a very sizeable fruit. It is desirable that younger men be introduced into the scene as otherwise it will be quite impossible to keep up the tempo of work. Older experts might still be consulted on vital issues but their time and energy need to be conserved in the interest of the country as well as their own.

Institution of Engineers, Delhi Centre

The Institution of Engineers, New Delhi Centre has been the scene of many and important functions. The Railway Standards Office Chief Engineer (Shri Venkatarammiah) addressed a special meeting explaining the techniques of welding. As is well known, the conservation of steel is an uppermost necessity in the country and it is only through the extensive use of welding that economies can be made in this material. At the same time welding is a new science and practical knowledge is of highest importance. For this purpose, the country needs to pool its knowledge and experience of welding so that this technique can be adopted with confidence. Instances were given by the speaker as well as by Shri Pande, Chairman Railway Board, Shri L. C. Verman, Director, Indian Standards Institution, Dr K. L. Rao, Chief Engineer Designs CWPC, and Shri C. L. Handa, Director, Bhakra Dam Designs Directorate, of the short range and long range measures which need to be adopted to popularize welding on an assured and scientific basis.

Matters pertaining to the Damodar Valley Corporation were discussed at a two-day Conference of the participating Governments which began in New Delhi on April 16, under the chairmanship of Shri G. L. Nanda, Union Minister for Irrigation, Power and Planning.

The Institution of Engineers, Centre was a scene of a well-attended social function, when Shri Pande, Chairman of the Delhi Centre was at home to the members of the Executive Committee and other prominent members of the Institution of Engineers. The function was made pleasant by the presence of large number of ladies who participated. The Delhi Centre is increasing its popularity by arranging many talks and illustrated shows. One other speaker who figured at the Institution Centre, was Mr. John C. King, Chief Engineer of the Intrusion Prepakt Company of Cleveland, Chio, U.S.A.

Absorption of Spare Personnel

The oustanding need still persists of the diversion of personnel from one project to another. The projects are bound to lay off, when the bulk of the work is finished and each management are interested in cutting down their establishment costs. The result is the reduction of personnel, technical and non-technical, from such projects without any suitable arrangement being made for the re-employment of such experienced personnel on other projects. This is a matter of vital importance to the nation and the attention of all concerned needs to be drawn to the gap in planning the implementation. It is high time that the Centre come out with a directive to the States not to reduce their technical and non-technical staff without first having made arrangement for employment of such staff on other projects included in the 2nd Five Year Plan.

There will be conservation of experience in this manner and in the long run the country will be the gainer. With the volume of the 2nd Five Year Plan so much in excess of the 1st Five Year Plan, it is axiomatic that more hands can be employed if the rate of progress is to be maintained.

Bhakra Nangal Scene

Eyes are again concentrated on the Bhakra Nangal project progress. The Dam is now coming up bucket-by-bucket and already over 100,000 cyds. of concrete have been poured by the 3rd week of April. The giant machinery that is operating in the manufacture and placement of concrete is working to plan and Indian Personnel are losing no time in acquiring the skill that is necessary to maintain and operate the huge expensive plant.

The Fertilizer and Heavy Water factory is also going to take shape in a practical way. Start is being made by the acquisition of some of the buildings and houses for the personnel of the Fertilizer Factory.

It has been stated in reliable quarters that the demand for fertilizer is likely to go up within ten years in the Nothern India region and may be as much as double of the present plant output of the Nangal Fertilizer Factory. The same applies to Heavy Water, because India can look forward to become on Exporter of heavy water if the same can be produced at an economical rate with cheap power.

Both these aspects are important features, and in modern planning it is important to take the prospect of the next 10 or 20 years, into account rather than only of tomorrow.

Editorial

Assuring Economy and Efficiency

It is gratifying that the Government of India has at last decided to establish standing high-power Committees which will organise investigations, including inspection in the field of important projects, both at the Centre and in the States, through specially selected teams. It will initiate studies with the object of evolving suitable forms of organization, methods, standards and techniques for achieving economy, advoiding waste and ensuring efficient execution of projects.

The committee's other fuctions will be (1) to promote the development of suitable machinery for continuous efficiency in individual projects and in agencies responsible for their execution : (2) to secure the implementation of the suggestions made in the reports submitted to the committee on development projects and to make the results of studies and investigations generally available ; and (3) to undertake such other tasks as the National Development Council may propose for the promotion of economy and efficiency in the execution of the Second Plan.

The projects for which committees will be established may be broadly classified as (1) Irrigation and Power ; (2) Public works and buildings ; (3) Agriculture and community development ; (4) Transport and communications ; (5) Public, industrial and mineral enterprises ; (6) Social services.

Each Committee will be composed of the Union Ministers for Home Affairs, Planning and Finance and the Deputy Chairman, Planning Commission. The Home Minister will be the Chairman of the Committee. The other members will be the Chief Ministers of States to be proposed by the Prime Minister in his capacity as Chairman of the National Development Council, for each class of projects as indicated above and the Union Minister concerned with the project or class of projects under investigation.

Many a time we had suggested through these columns that a central body is necessary to keep a watch over the efficiency and economy of the very large and growing number of projects specially in the field of river valley, irrigation and power. In addition to promoting efficiency and economy, this will also help in promoting standardisation of methods and rates and costs and use of equipments for similar work under similar circumstances. We are glad that, howsoever belated, the Government has accepted this proposal.

The structure of the Committees suggested by the Finance Minister appears to be too cumbersome. As a consequence, it is very likely that the purposes for which the Committees are being set up will be very inadequately served. The Committees themselves may then need to be inspected and scrutinised for purposes of its efficient functioning. We would rather suggest that the new Committees for Inspection and Scrutiny should be placed under one senior Minister at the Centre who should have no other responsibility and who should enjoy a degree of confidence as that enjoyed by the Auditor General. An efficient and effective inspectorate uninfluenced by political and other considerations would contribute mightily to the promotion of a sound economic development of the country in the context of the Second Five Year Plan where the public sector enterprises will be multiplying many times over and where the element of competition will be comparatively absent.

In this connection it is legitimate to raise another important issue. Now that the Government has decided to take over a large sector of economic development under State-enterprise, how does it propose to assure economy and efficiency of operation on the one hand and public interest on the other ? The State enterprises that are already in existence have not been evaluated properly in this regard. Higher cost of production, waste, increase in prices and general inefficiency have been rampant, as may be seen from the successive reports of the Estimates Committees and Public Accounts Committees of the Centre and of the various States. While public interest needs to be guaranteed in the realm of economic development, it is equally necessary to assure that the costs of inefficiency, wastage and bureaucracy are not borne by the public. The experiment in autonomous corporation system has not been given a fair chance mainly because the politicians are not prepared to devolve executive powers. The private company method has rightly been described as "a fraud on the public." The departmental system is a worn-out practice. We wonder if the Government is fully aware of the implications of their blind determination to take up much more at one bite than they can chew.

It may be of interest to quote here what we wrote as early as in October 1953, referring to Pandit Nehru's speech delivered at the Annual Meeting of the Central Board of Irrigation ; "Prime Minister Nehru was amazed at the lopsided development of the State organisation. He illustrated his observation by the imagery of a man with his hands and feet growing faster than his brain. This tendency to multiply in quantity abnormally and without reference to quality is inherent in the ideology of statism, where state tries to take up all kinds of work upon itself. Is it not possible, nay, would it not be conducive to more efficient execution, if the Government in most cases planned and supervised the work rather than executed it itself ? The executing body may more and more be of the autonomous corporation type, so that the public nature and interest of the project may be safeguarded and democratic control over policy questions may be retained. After all a plan benefits the community as a whole and the latter's endeavour is of crucial importance in the matter of successful implementation. Why then should not the executing organisation be based mainly on the foundation of mutual cooperation between the government on the one hand and the community on the other ? The main function of the Government should be planning, direction, control, supervision and checking. If most of execution work is left to groups of citizens suitably organised for specific types of activities, much of the tendency to expand and multiply in government departments will be reduced. Will the government consider the problem from this angle ? It will then be possible for the government to emphasize on quality in every sphere of its activities. At present it is so much taken up and overwhelmed by its own activities that it has hardly time to pause and ponder." How much more will this problem be intensified during the Second Five Year Plan period ?

Letters to the Editor

DEAR SIR,

I read the interesting article "Magnetised Currents" by Sri B. K. Gokhale in the February issue of the Indian Journal of Power and River Valley Development. As he has pointed out, it is perfectly true that science has not said the last word or given the last explanation for so many of the phenomena of nature that continue to defy solution. His speculation that the persistent purity of the Ganga water in spite of enormous contamination on its way might be a result of magnetisation of the water from Rishis in the Himalayas may be a flash of understanding which is often sensed by the poet first and later proved by the scientist. But, for the same phenomenon, if it can be proved more true in the case of the Ganga than in any other river, there can also be, at least partly, a more plausible explanation.

The heat and ultra-violet light of the powerful tropical sun which beat down on the long course of the Ganga are no mean disinfectants. It is also entirely within reason to believe that the river draws to itself many organic and inorganic components from the bed and banks and its entire catchment, which help keep down the growth of pathogenic organisms. For instance, metallic elements that go into solution from the bed of the river, and are actually found in miniute quantities in river waters, do not encourage the growth of disease germs. The numberless antibiotic organisms which are being discovered in the soil, and are being cultivated by biochemists for isolating new antibiotica, are a perennial source of disinfecting agents which the Ganga might be drawing into itself along its route of more than a thousand miles. Mere oxygen itself, as is well known, is an enemy to the anaerobic class of organisms.

Thus I believe science, even in its infancy, can explain to some extent one of the sacred virtues attributed to the Ganga.

But all this is not to justify the superior attitude of man to the forces of nature, which is clearly born of immaturity and insufficient appreciation of the beauty, enormity and timelessness of the universe and its elements. But perhaps the author will agree that, to impress a child, one will have to speak its language.

Yours sincerely,

K. S. RANGAPPA

The only language of understanding available to man evolved by him is the language of Science. The method of science is the most reliable, public and communicable yet had in the pernnial search of man towards the understanding nature. Therefore, it is natural that modern man would like to use this method alone to explain many a natural phenomena, including the characteristic property of the Ganges Water. So long as this premise is accepted, there is no difficulty. Poetry can not be substituted for science—Editor.

(*Continued from page* 26)

Financial Problems facing the Private Electricity Undertaking

since ruled that so long as the depreciation for the year and any instalments in respect of arrears are appropriated there can be no bar to payment of dividends above 3%. This Company never admitted to having any arrears in any case, but the general result is satisfactory and solacing to investors, who had been much worried. This ruling settles one more controversy between the State Governments and the Undertakings in favour of the Industry. Another matter recently settled in the Industry's favour is the right of an Undertaking to increase its rates to enable it to reach the Reasonable Return under the Electricity (Supply) Act although the rates will there by be brought into excess of the maxima laid down in the Company's Licence.

We have through constant and successful effort so increased the efficiency of the Company's operations as to have been able to counteract a number of those increases in cost which are beyond our control. With coal in particular, a substantial saving, counted in lakhs of rupees, has been effected during the year under review by reason of an average coal consumption of 1.5 lbs./kWh being attained, and this despite deterioration in quality of the coal received. There is a limit, however, to our ability to absorb rising costs, and nowadays much of the increased cost arises from burdensome levies of the State or of Government monopolies, the latest being the Surcharge to be imposed by the Railway Ministry from the first of next month.

No one can cavil at Government's policy of intervening to shield its citizens at large, whether industrialist, businessman or householder against obviously undue burdens being place on them by monopolists or others. It is, however, exasperating in the extreme for us to see so much time and effort being given by Rating Committees to the examination of the affairs of Electricity Supply Undertakings whose books show they need to increase their rates, and where the necessary actions by and large will have a very small effect on a manufacturer's production cost or on a householder's budget, while state monopolies literally by a stroke of the pen impose much more far-reaching economic burdens on us all, without the public knowing anything about any investigation into their affairs.

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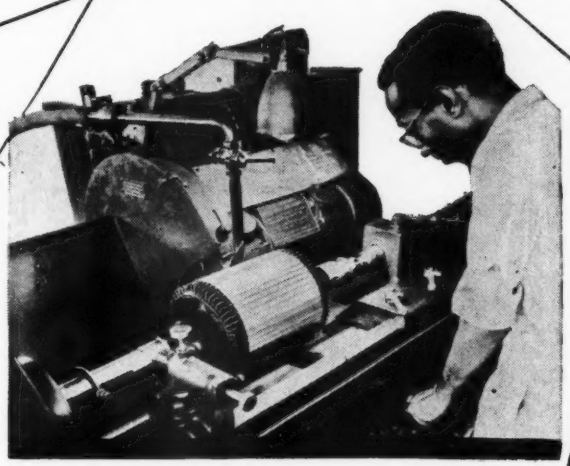

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